USAID | PREDICT

FROM THE AMERICAN PEOPLE

2015 ANNUAL REPORT

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UCDAVIS VETERINARY MEDICINE One Health Institute

WILDLIFE CONSERVATION SOCIETY

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REDUCING PANDEMIC RISK, PROMOTING GLOBAL HEALTH

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This publication was prepared by the PREDICT Consortium headquartered at the One Health Institute (OHI), School of Veterinary Medicine, University of California, Davis.

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Cover: *A boy with camels at a market in Egypt. PREDICT is investigating the camel value chain and camel, bat, and human interactions as part of targeted surveillance for Middle East Respiratory Syndrome (MERS) and MERS-like Coronaviruses that could pose a threat to people* (Source: Maureen Miller, EcoHealth Alliance).

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REDUCING PANDEMIC RISK, PROMOTING GLOBAL HEALTH

PREDICT, a project of USAID's Emerging Pandemic Threats (EPT) program, was initiated in 2009 to strengthen global capacity for detection and discovery of zoonotic viruses with pandemic potential. Those include coronaviruses, the family to which SARS and MERS belong; paramyxoviruses, like Nipah virus; influenza viruses; and filoviruses, like the ebolavirus.

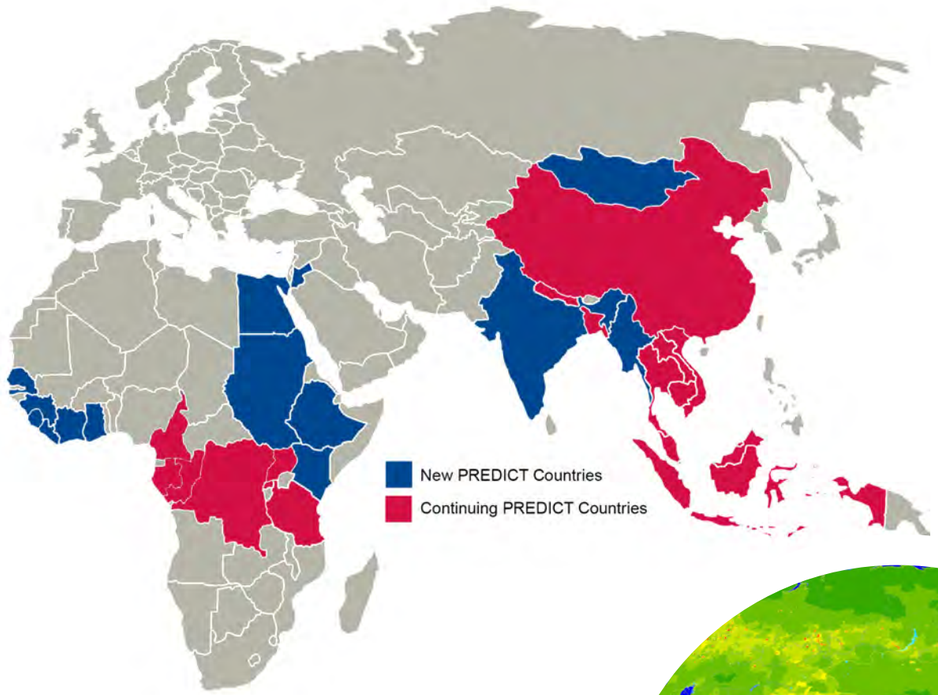
PREDICT has made significant contributions to strengthening global surveillance and laboratory diagnostic capabilities for new and known viruses.

Now working with partners in 31 countries, PREDICT is continuing to build platforms for disease surveillance and for identifying and monitoring pathogens that can be shared between animals and people. Using the One Health approach, the project is investigating the behaviors, practices, and ecological and biological factors driving disease emergence, transmission, and spread. Through these efforts, PREDICT will improve global disease recognition and begin to develop strategies and policy recommendations to minimize pandemic risk.

SURVEILLANCE

PREDICT's surveillance for emerging pathogens focuses on areas of the world at the highest risk for zoonotic disease emergence. The goal is to move countries away from a reactive post-outbreak response to a proactive approach in which pathogens of pandemic potential are discovered at their source before large-scale epidemics occur in people.

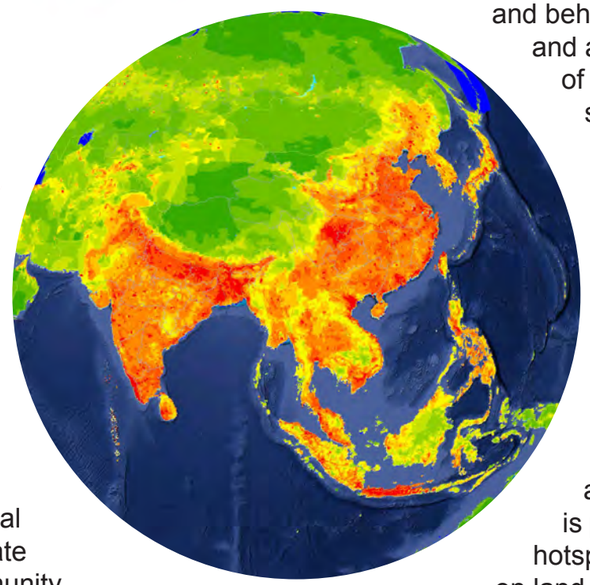
PREDICT's disease surveillance strategy is based on the inextricable link between animals, humans, and the environment. Rather than prescribing an across-the-board surveillance plan, PREDICT works in each focus country to cultivate targeted, measurable, adaptive, and responsive approaches that are integrated across health and environmental sectors.



CAPACITY STRENGTHENING

Preparing for emerging disease threats requires investments in infrastructure, institutions, and human resources across a broad array of health and social systems to operationalize One Health platforms. In collaboration with country governments and EPT partners, PREDICT is committed to developing the infrastructure and core skills and capabilities required by tomorrow's One Health workforce.

Through PREDICT, more than 2,500 people (and counting) have been trained in biosafety, field epidemiology and surveillance, laboratory diagnostics, social sciences and behavioral risk investigations, and modeling and analytics, creating an extensive network of global One Health professionals to support long-term zoonotic disease surveillance.



PATHOGEN DISCOVERY & DIAGNOSTICS

PREDICT's diagnostic success lies in the use of broadly reactive consensus (genus/family level) PCR supplemented with high throughput sequencing. These powerful tools produce specific, high-resolution data allowing for rapid detection of known and new potential pathogens. To date, PREDICT has developed and optimized detection protocols and capacities in laboratories in all of the countries in which we have engaged, ensuring regional capacity to detect pandemic threats.

The PREDICT approach is especially important for the diagnosis of mystery illnesses in medical hospitals and veterinary labs where testing options are often limited. By testing targeted samples based on the circumstances that promote disease transmission and the route of exposure, PREDICT can detect known and novel pathogens in tandem, rather than sequentially.

BEHAVIORAL RISK

PREDICT uses a multidisciplinary approach to identify groups of populations at highest risk of exposure to emerging pathogens, and the 'how' and the 'why' of risk.

Our teams assess community perceptions of animal exposure and disease risk and evaluate widely held assumptions of community practices (e.g., high risks from bushmeat hunting). PREDICT is identifying and monitoring the risk factors for zoonotic diseases with pandemic threat potential.

Our methods will lead to well-rounded understanding of disease spillover and transmission dynamics, essential to the design and evaluation of mitigating interventions, and to informing policy by identifying barriers to change and acceptable alternatives.

MODELING & ANALYTICS

PREDICT will use state-of-the-art modeling and analytic approaches to guide surveillance and help countries develop disease control and prevention strategies. PREDICT is producing next-generation, fine-scale hotspots maps, combining in-country data on land use, socioeconomic, and agricultural changes with surveys of human behavior, market value chains, and livestock production to identify where zoonoses will spillover, where they will amplify, and who is at risk.

By using data direct from PREDICT viral testing and conducting outbreak scenario modeling, PREDICT will provide information on which pathogens are most likely to become pandemic and which control and mitigation strategies can be most effective.

INFORMATION MANAGEMENT

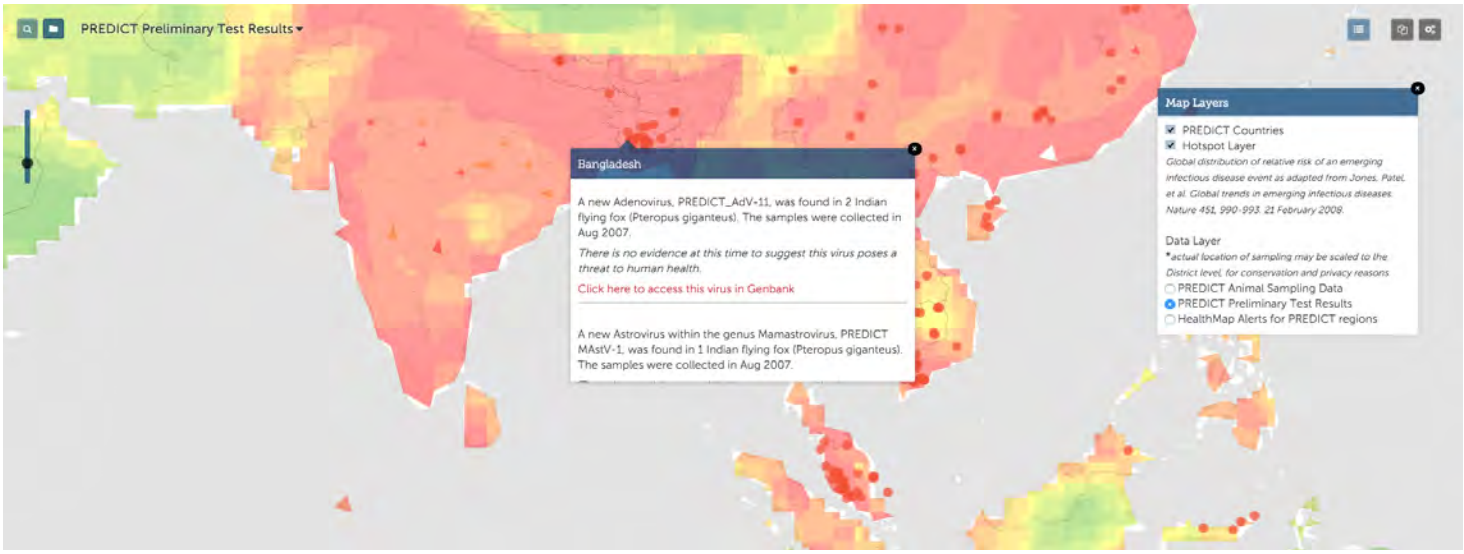
PREDICT works closely with host governments and partners to interpret and share information through systems designed to protect and ensure data quality and accuracy. PREDICT data are managed in a purposefully-designed internal information management system, in which all data undergo a rigorous quality control process. Diagnostic test results are interpreted in light of all available scientific literature by PREDICT virologists.

After interpretation, results are provided to host governments for examination, to inform policy, and for approval for public release through the PREDICT data site powered by HealthMap. This open access platform allows users to visualize PREDICT data along with disease events worldwide (http://data.predict.global).

ONE HEALTH PARTNERSHIPS

PREDICT at its core is built upon One Health partnerships. Cross-disciplinary collaborations are critical for gaining a more full understanding of the integral links between human, animal, and environmental health that can provide opportunities for prevention or early detection and control of disease threats. By working across sectors and including a diverse range of stakeholders and expertise, PREDICT helps operationalize efforts that promote public health, effective natural resource management, and development.

On a country basis and at a global level, PREDICT enables and supports implementation of One Health practices. Toward this goal, PREDICT has worked closely with a wide range of government ministries, scientific institutions, local organizations, and other stakeholders to further One Health initiatives. These have taken the form of inter-ministerial data sharing and interpretation, interdisciplinary capacity building and surveillance, and coordinated outbreak response activities. Building on these best practices, PREDICT is working with Emerging Pandemic Threats program partners to develop an evidence base to demonstrate the value of the One Health approach.



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I. SUCCESS STORIES

SECTION 1. SUCCESS STORIES

Throughout 2014-2015, PREDICT focused on planning to operationalize surveillance under the new EPT-2 program and to establish One Health platforms in new countries and areas of engagement. In the midst of planning and coordination with continuing and new EPT-2 and Global Health Security Agenda (GHSA) partners from US agencies, the World Health Organization (WHO), the Food and Agricultural Organization (FAO), Preparedness and Response (P&R), One Health Workforce (OHW), along with regional and national partners and networks, PREDICT made significant strides towards strengthening One Health capacity from field to lab, in supporting disease outbreak investigations and national capacity and policy for outbreak preparedness, and towards developing and integrating social science expertise to improve understanding of the human behaviors associated with viral spillover and transmission. Select Success Stories from this year are highlighted here. Additional information is available throughout the Annual Report and is noted where applicable for reference.

Members of the PREDICT Cameroon team with PREDICT's Deputy Behavioral Risk Coordinator, Dr. Karen Saylors. (Source: Metabiota, Inc.)

EBOLA VIRUS DISEASE PREPAREDNESS AND SURVEILLANCE

PREDICT provided expert guidance and support in Ebola control and outbreak response over the course of Year 1: In the **Democratic Republic of Congo** (DRC), PREDICT actively participated in the Boende Ebola Outbreak Laboratory and Research Commission and was engaged in the development of training manuals and national Standard Operating Procedures (SOPs) for EVD outbreak response. In **Uganda**, the PREDICT team participated in a workshop with the Ministry of Health and partners in Entebbe to review and develop SOPs and guidelines for Ebola and Marburg virus disease management from detection and initiation of effective response to effective implementation of outbreak control measures, taking lessons from the West Africa Ebola outbreak; additionally the Uganda team assisted with the review of the structure and composition of the National Task Force. In **Cameroon**, PREDICT successfully tested an Ebola real-time PCR assay using a synthesized positive control, led or contributed to workshops and presentations on Ebola preparedness, and provided key counsel in the development of an Ebola readiness assessment and a draft document detailing roles of Ebola rapid intervention teams. The PREDICT **Indonesia** team contributed to the national disaster agency's workshop on Ebola outbreak contingency planning. Finally, in **Thailand**, government officials began screening arrivals to Thailand for suspected Ebola infections using PREDICT protocols, and PREDICT Thailand team members presented on EVD at multiple national meetings.

Pigs in a culvert, Salone, Sierra Leone. PREDICT initiated plans to identify reservoir, transient, and spillover hosts of ebolavirus in three key West African countries. (Source: Metabiota, Inc.)

In **DRC**, the PREDICT team prepared three genome sequences of the ebolavirus detected during the Boende Ebola Outbreak in DRC (2014) in collaboration with University of California San Francisco (UCSF) lab and submitted the sequences to GenBank (KP271018-KP271019-KP271020). At the time of the outbreak, it was not clear if the Boende outbreak was related to the outbreak in West Africa. By releasing these sequences publicly, PREDICT was able to demonstrate that they were separate outbreaks of ebolavirus. Further, upon request from the DRC Ministry of Health (MoH), the PREDICT DRC team organized a trip to Boende in the aftermath of the Ebola Virus Disease (EVD) outbreak to collect wildlife specimens for filovirus testing. During the visit the team collected a total of 255 samples (from 41 bats and two rodents).

The DRC team prepares a canoe in Boende with bat capture and sampling gear in the aftermath of the Ebola Virus Disease outbreak. (Source: Metabiota, Inc.)

This year, the PREDICT modeling team conducted a statistical analysis of demographic factors (e.g., number of cases at detection, regional population density) for historical ebolavirus outbreaks to identify any unique factors that may have contributed to the unique spread of the West Africa outbreak. Further, the team examined changes in global airline travel volume and international connectivity when travel sanctions are put in place using the West Africa ebolavirus outbreak as case study. An economic analysis was also conducted on specific intervention strategies enacted or proposed for the West Africa outbreak.

In the West Africa region, the PREDICT team developed a strategy to evaluate multiple potential hosts of Ebola in the three most affected West African countries as reservoirs or transient spillover hosts to help shed more light on the disease dynamics.

SUPPORTING NATIONAL OUTBREAK RESPONSE CAPACITY

PREDICT's **DRC** Country Coordinator Prime Mulembakani received a nomination from the DRC Minister of Health to be a member of the national team of first responders in case of chemical, biological, radiological and nuclear (CBRN) hazard and contributed to the preparation of the national action plan for CBRN threats. PREDICT's DRC team was also designated by the North Kivu Provincial Division of Health as a standing invitee to its bi-weekly epidemio-surveillance meetings in Goma, where all human disease cases in the Province are reported and discussed. Further, the DRC team received the express support of the North Kivu Provincial Inspector of Human Health to work in two health zones around Virunga National Park (Bunagana and Rwanguba), enabling Virunga National Park (PNVi) to assign its head nurse to visit 14 community health centres surrounding the Mikeno Sector of PNVi (Bunagana, Bugusa, Kabonero, Shangi, Rutsiro, Kabaya, Kabindi, Tanda, Kazuba, Rugari , Kakomero, Kingarama Gasizi and Kibumba), to identify centres for collaboration and to assess their capacity to store samples and participate in human health surveillance.

The DRC team, led by Ipos Ngay and Placide Mbala, working with community members in Boende after the Ebola Virus Disease outbreak. (Source: Metabiota Inc.)

In **Cameroon**, PREDICT, together with representatives of the Food and Agriculture Organization of the United Nations (FAO), Preparedness & Response (P&R), One Health Workforce (OHW), and USAID, was received by the Prime Minister of Cameroon to discuss the Emerging Pandemic Threats-2 (EPT-2) program and disease emergence in Cameroon.

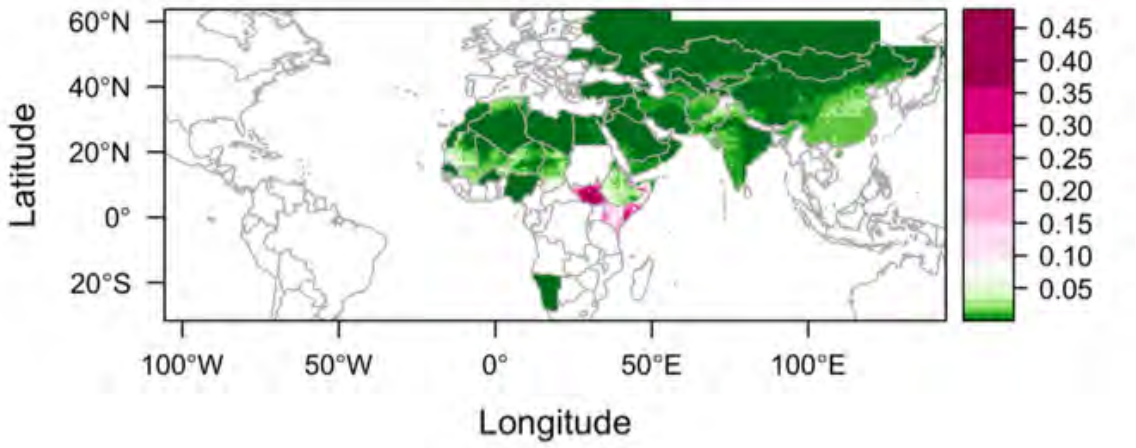
In **Rwanda**, PREDICT was invited to participate in the drafting of a One Health work plan under the Government of Rwanda's One Health Strategic Plan 2014-2018, and the team identified activities for which PREDICT will aim to provide technical support. Further, the Rwanda team was alerted by the Rwanda Development Board (RDB) to the first ever report of respiratory disease affecting wild human-habituated chimpanzees in Nyungwe National Park, a priority surveillance area, and upon invitation by RDB, the team opportunistically collected fecal samples and forage material from sick chimpanzees in support of Rwanda's expanding response capacity for outbreaks among wildlife populations, especially those that could be hosts or susceptibles of ebolavirus.

PREDICT's Rwanda team led by Country Coordinator Julius Nziza (second from left) preparing traps for disease surveillance activities. (Source: Gorilla Doctors)

In **Uganda**, the PREDICT team, led by Country Coordinator Benard Ssebide, briefed the Government of Uganda's State House in Entebbe in March during a government-led primate capture and sampling exercise on State House grounds. The team also presented on the public health risks posed by human-primate contact and the purpose and objectives of the PREDICT-2 project to the President's office.

MERS AND OTHER CORONAVIRUS (COV) SURVEILLANCE

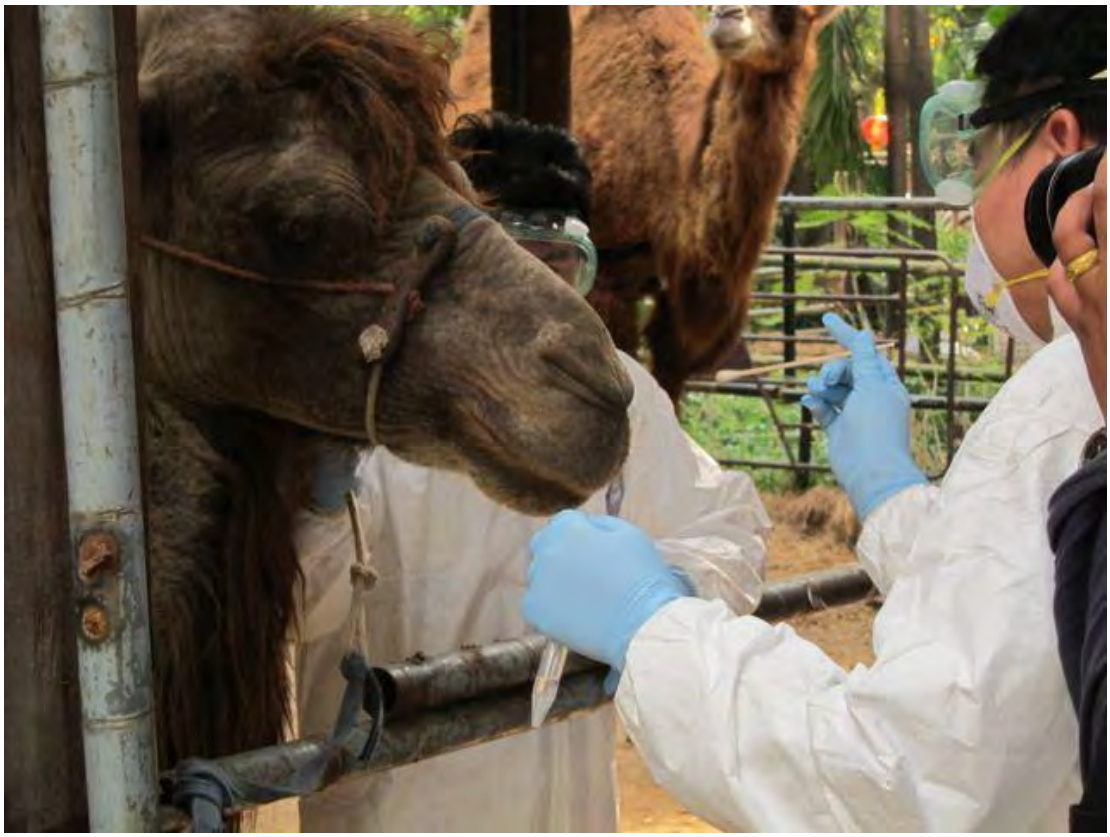
The PREDICT Modeling team finalized “Outbreak Scenario” models and developed two-page summaries for MERS-like coronavirus (spread from slaughtering imported camels – Section 6.4) and MERS-like Coronavirus from bat guano (Thailand). Further, the team completed a MERS-epizone spatial spillover risk model, combining geographic range of potential bat reservoir host and national data on dromedary camel densities and developed a preliminary SIR model for circulation of MERS-CoV within camel populations based on herd size, connectivity, and market structure to guide surveillance of camel populations and to forecast the potential effect of livestock intensification on changes in MERS disease dynamics in Africa and the Middle East.



Hotspot map for risk of MERS-like virus spillover from bats to camels (See Section 6.4 for more information).

In **Thailand**, the PREDICT team detected the first human MERS-CoV case in-country. The MERS-CoV infection was first confirmed at the PREDICT lab at Chulalongkorn University, and viral family protocols were used to compare to the sensitivity of the WHO protocol. The result was reported to MOPH within eight hours, with sequence confirmation following within 24 hours after receiving the specimen. The nasopharyngeal swab specimen collected on the same day and tested by the other two Thai laboratories showed an inconclusive/negative result.

In **Bangladesh**, the PREDICT team assisted with the first MERS-CoV surveillance activity in-country by collecting samples from 60 dromedary camels from a live animal market in Dhaka. The camels were imported for an annual festival and sampled to screen for MERS coronavirus. These samples will be tested for coronavirus RNA and antibodies against MERS CoV at icddr,b. Lab reagents for testing were provided to the PREDICT partner lab by NIH NIAID Rocky Mountain Labs.



A technician practices camel sampling techniques during a training workshop. PREDICT has been targeting camel and bat populations to learn more about the epidemiology and disease transmission risks of Middle East Respiratory Syndrome (MERS) and other MERS-like Coronaviruses that might represent a public health risk. (Source: EcoHealth Alliance)

In **China**, PREDICT detected a novel coronavirus clustering with the SARS-like coronaviruses in *Rhinolophus* bats from Guangdong. Further characterization of this Beta Coronavirus is underway, including sequencing of the spike protein, to determine if it has the potential to infect other hosts.

UNDERSTANDING HUMAN BEHAVIORS AND RISKS FOR DISEASE EMERGENCE AND SPREAD

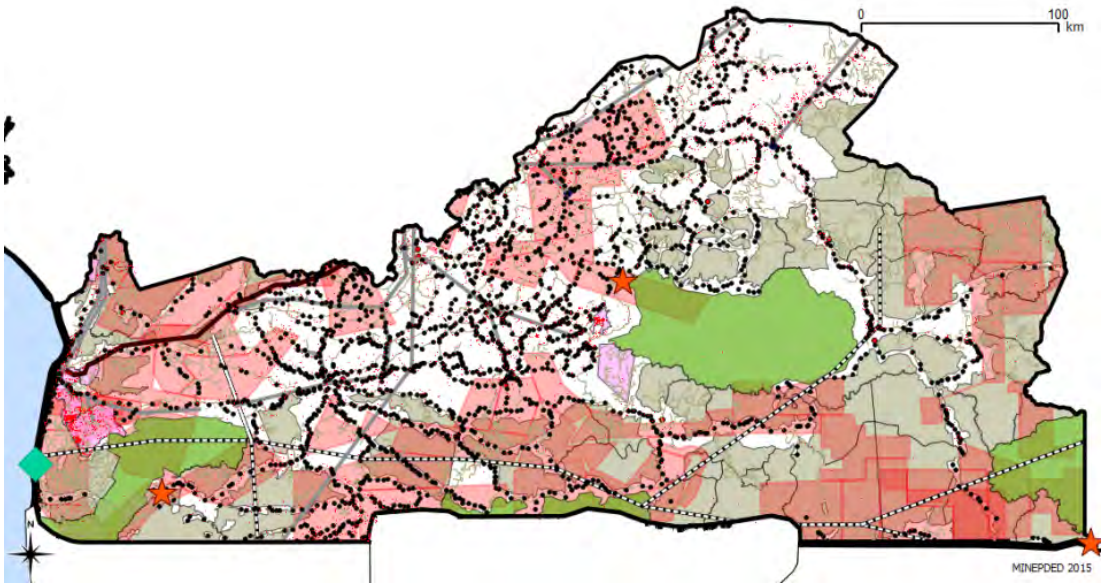
This year PREDICT conducted trainings in five priority countries targeted for behavioral risk research (**China**, **Bangladesh**, **Uganda**, **Cameroon**, and **DRC**). Notably, 88% (15/17), 88% (28/32) and 86% (12/14) of individuals trained in China, Bangladesh, and DRC, respectively, were not PREDICT staff or were new to the project, demonstrating PREDICT's contributions to developing local capacity in critical, but often overlooked, disease surveillance methodologies. Following local IRB approval for qualitative research activities, PREDICT initiated data collection in Bangladesh, China, and DRC.

In Bangladesh, a man feeds a macaque. This common behavior often results in bites, scratches, and injuries that pose risks for disease spillover between macaques and people. PREDICT has been investigating interactions like these with a new cadre of trained behavioral scientists through qualitative research methods to help better understand human-animal interactions and help identify potential intervention strategies to prevent disease transmission. (Source: EcoHealth Alliance)

PREDICT expanded the core capabilities of the **China** team to include skills and expertise in behavioral risk investigations through trainings in human behavioral data collection in Yunnan, Guangxi, and Guangdong. All materials, guides, and data collection tools for behavioral risk activities (Behavioral Research: "Qualitative Research for Behavioral Risk Surveillance and Characterization") were translated into Chinese and provided to teams including the ethnographic interview guides, focus group guides, and observational protocols (see Section 6.3). In total, 17 individuals received training with the teams implementing new skills as activities were initiated in Yunnan, Guangxi, and Guangdong. Following the training, the team conducted approximately 65 ethnographic interviews and four focus groups in Yunnan, Guangxi, and Guangdong. Preliminary findings suggest that there is a consistent perception that wildlife is dwindling, though bats continue to be opportunistically hunted and eaten. One intervention implication is potential conservation readiness, since communities express distress at the change in wildlife abundance due to overhunting and environmental degradation.

EXTRACTIVE INDUSTRIES AND PUBLIC-PRIVATE PARTNERSHIPS

In recognition of the potential for disease emergence and transmission associated with the extractive industries, PREDICT worked this year to plan surveillance around areas impacted by extractive industry operations. In Cameroon, the team liaised with officials from Sud Cameroun Hevea SA (SUDCAM), an agroindustrial and rubber-producing company currently expanding plantations in-country, to discuss opportunities for operational alignment and to assess the rubber expansion zone as a possible surveillance site. In the **Republic of Congo (RoC)**, PREDICT obtained country maps indicating areas of extractive industry activity, identified key regions at high risk for disease transmission along human-wildlife interfaces, and produced a table detailing the location and importance of biodiversity and the presence or absence of extractive industries to facilitate site selection.



Map showing a segment of Cameroon with overlapping land use types, including the extractive industries. PREDICT is investigating relationships among the extractive industries, human and animal contact, and viral emergence in areas undergoing land-use change. (Source: Cameroon Ministry of Environment, Nature Protection and Sustainable Development - MINEPDED)

STRENGTHENING THE ONE HEALTH WORKFORCE

In **Cambodia**, PREDICT engaged government partners from the Cambodia CDC, Ministry of Agriculture and the Forestry Administration to develop a coordinated One Health field approach to establish a multi-sectoral field team with animal, human health, and forestry government counterparts and successfully went into the field as a One Health team to complete pilot sampling of rodents and bats in areas where the cross-border rodent trade occurs.

Preparing for field sampling in Kandal with the Department of Animal Health and Production and the Forestry Administration. PREDICT is helping to develop and deploy One Health teams for disease surveillance in Cambodia. (Source: UC Davis)

Over the course of two weeks in **Indonesia**, PREDICT successfully trained lab staff (11 individuals, four of them women) from the Ministry of Agriculture Laboratories and Disease Investigation Centers (DICs) Maros and Banjarbaru in laboratory safety and intensive hands-on laboratory investigations from sample extraction to final sequencing of positive specimens. In addition, follow-up trainings were organized in collaboration with FAO on bioinformatic analysis of sequence results from domestic animal screening. During the trainings, mammal and avian domestic animal specimens from DICs at Maros and Banjarbaru were screened for three viral families (Coronaviridae, Paramyxoviridae, Herpesviridae) and two additional viral pathogens (Influenza A, and Encephalomyocarditis virus) using PREDICT protocols. Results were sent by DICs to MoA Director of Animal Health. As a result, MoA and DIC lab staff are well equipped with the knowledge and technical skills to complete viral detection and discovery activities.

In **Malaysia**, PREDICT contributed to the training of PREDICT implementing partners and the development of Malaysia's One Health workforce by training 35 wildlife staff from Sabah Wildlife Department, Lok Kawi Wildlife Park, and Sepilok Orangutan Rehabilitation Centre in zoonoses, biosafety, PPE (with respirator fit testing), safe animal capture and handling, risk assessment, and lab safety. In addition, conducted multiple trainings with Wildlife Health Unit and DGFC staff, including field and lab first aid trainings for three PREDICT, three WHU, and six DGFC staff and biosafety, PPE use, safe animal handling, sampling of bats and non-human primates, cold chain maintenance, and safe transport of samples for 15 individuals from WHU DGFC, Borneo Sun Bear Conservation Centre, University Putra Malaysia, and British Columbia Institute (See Training Summary below for details). As a result, WHU, DGFC, and other wildlife professionals in Sabah are equipped with more knowledge and technical skills required for field surveillance and safe handling and sampling of wildlife and are sensitized to animal mortality events that may represent a risk for viral spillover or disease emergence.

PREDICT Malaysia Country Coordinator Tom Hughes poses with the Wildlife Health Unit in Sabah comprised of partners from the Sabah Wildlife Department and Danau Girang Field Centre. PREDICT has been training WHU and DGFC personnel in biosafety, personal protective equipment, and safe handling and sampling of animals and working to develop their capacity for conducting disease investigations in animal populations. (Source: EcoHealth Alliance).

ASSESSING PANDEMIC THREAT IN THE WAKE OF A NATURAL DISASTER

In **Nepal**, the PREDICT team worked to identify areas for support of infectious disease control in disaster relief efforts following the 2015 earthquake. Contributions to the disaster response included producing and distributing informational disease outbreak prevention and risk communication materials (posters and brochures – Section 6.5), and working with PREDICT partners at HealthMap to develop a digital disease detection and monitoring platform of health alerts and events to improve situational awareness of potential infectious disease threats (the site is publicly available at http://www.healthmap.org/nepal/).

A macaque perched on rubble in the aftermath of the earthquakes that devastated the Nepal and the Kathmandu Valley, chews a dental rope used by the PREDICT Nepal team to collect samples without causing harm to the animal or field technician. (Source: UC Davis)

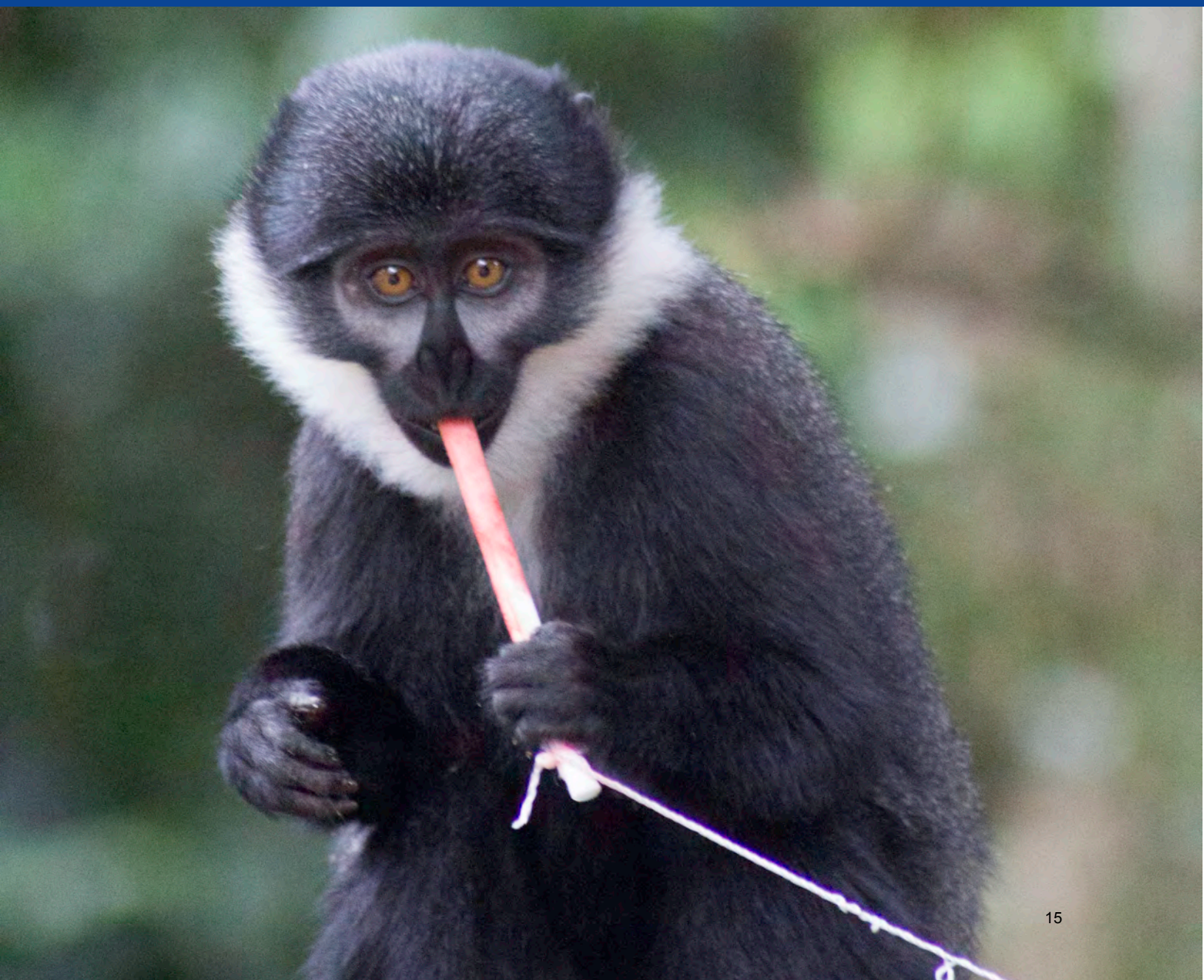
REGIONAL NETWORKING AND COORDINATION

Over the past year, PREDICT contributed to a number of regional (multi-national) training and coordination meetings for zoonotic disease surveillance: In **Cameroon**, PREDICT joined the FAO-led Regional Network of National Epidemiosurveillance Systems for HPAI and Other Priority Animal Diseases in West Africa (RESEPI) and the West and Central Africa Veterinary Laboratory Network for Avian Influenza and other Transboundary Diseases (RESOLAB) meetings. In **Tanzania**, PREDICT trained 15 international veterinary students and one human medical student in One Health and PREDICT's approach to disease surveillance. Further, a number of PREDICT in-country teams have presented at international symposia on One Health and infectious diseases, including the International One Health Congress (Amsterdam, Netherlands), Readiness, Prevention and Resolution of Emerging Infectious Diseases (Bangkok, Thailand), and the International Congress on Pathogens at the Human-Animal Interface (Chiang Mai, Thailand).

With the support from PREDICT **Cameroon** and a member of the Department of Forest Economy, the PREDICT **RoC** team participated in trainings in safe animal sampling methods and information management, with sessions in Brazzaville and the Sibiti region of the Lékoumou Department, 300 km to the northeast. The training included hands-on and in-service instruction in capture and sampling methods, and during the session 558 samples were collected from bats and small rodents. PREDICT teams in the Central Africa region are increasingly engaged in cross-country collaborations like these trainings, which are supporting the development of a broader African cadre for disease response, including Ebola.

The PREDICT team in Republic of Congo processing samples from rodents and small mammals. (Source: Global Viral)

II. GLOBAL REPORT



PREDICT YEAR 1 ANNUAL GLOBAL REPORT (October 2014-September 2015)

Objective 1. Managing and Coordinating Operations

Establish and maintain collaborative and adaptive management of program operations and ensure compliance with agency policies and procedures.

- Generated, submitted, and obtained approval for EPT-2 workplans and budgets.
- Fully executed subawards with consortium and international partners in continuing PREDICT countries and initiated subaward approval processes with partners in new countries.
- Established financial and technical monitoring and reporting procedures and responded to all requests for information and reports from EPT and GHSA partners.
- Provided guidance on administration and compliance questions with subawardees.
- Created and maintained staff travel log and migrated travel log content to shared calendars for EPT partner coordination.
- Developed and implemented Environmental Management and Monitoring Plans and reporting with all consortium and implementing partners.
- Operationalized communications with Management Team and Executive Board and information flows with operational teams and implementing partners.
- Renewed and amended IACUC protocols to include new countries and sampling targets for continuation of animal sampling activities under revised scope of work.
- Convened a consortium-wide human subjects research working group, held meetings with the Director of the UC Davis IRB administration, and established reliance agreements with all consortium partners to extend UCD coverage for human subjects research across all sites (EcoHealth Alliance and Metabiota completed; WCS and Smithsonian Institution in progress).
- Submitted a Master IRB protocol to the UCD IRB for approval of all human subjects research and established procedures to ensure compliance among all sites engaged in human subjects research at global and local levels; responded to all levels of concerns; anticipating IRB approval in January 2016.
- Developed global and in-country staff contact information spreadsheet to facilitate communication and coordination among EPT partners at all levels.
- Introduced project to all new countries, coordinating with Missions and country governments.
- Considered and responded to all coordination concerns from USAID, FAO, WHO, and other partners and stakeholders; adapted workplans as appropriate.

Objective 2: Characterizing Biological and Ecological Risk

Identify the biological and ecological drivers and host-pathogen dynamics at high-risk interfaces within three critical pathways of disease emergence and spread in Asia and Africa.

Activity 2.1. Targeted monitoring for zoonotic viruses with pandemic potential at specific high-risk interfaces

- Held biweekly surveillance calls with operational leads and regional surveillance leads to provide direction and support for standardized surveillance operations across Asia and Africa.
- Developed surveillance data collection tools for 1) site and event characterization with data on animal-human contact, landscape change, and animal and human host ecology; 2) animal information with data on animal contact with people and condition at sampling; 3) sample data including sample type and condition; and 3) human data including data on occupations, travel, medical history, and animal contact. Resulting data collection tools (Objective 4 below and Section 6.1 and 6.2) for sites, animals, and humans have standardized terms and modules that link across high-risk interfaces and disease emergence pathways to allow implementation of the first ever data collection system standardized across animal, human, and ecological risk.
- Identified high priority disease emergence pathways, target sites for concurrent sampling, and high-risk taxa for focused surveillance activities in 31 countries.
- Engaged with FAO on livestock sampling coordination, both broadly in EPT partner meetings and via regional and in-country meetings, to prioritize site and animal targets along high priority disease emergence pathways.
- Explored opportunities for collaboration and coordination at the country level with local Ministries of Health and WHO regarding involvement in surveillance activities and reporting frameworks for surveillance data and policy development (globally and locally).
- Engaged WHO at EPT partner meetings and involved in-country WHO counterparts in selection of clinic and hospital partners for syndromic surveillance of undiagnosed severe acute respiratory illness (SARI), influenza-like illness (ILI), acute encephalitis, and hemorrhagic diseases in humans.
- Developed and shared detailed surveillance plans for 31 countries with EPT partners to facilitate alignment of in-country plans for concurrent surveillance specifically with regard to surveillance locations, target animal taxa, data collection, diagnostic testing plans, and laboratories.
- Implemented plans for longitudinal and concurrent surveillance at high priority sites in which wildlife sampling is being initiated, livestock sampling is coordinated with FAO, and human surveillance activities are prioritized in sequence with syndromic surveillance at collaborating clinics/hospitals implemented first and significant findings used to direct

occupational/community surveillance at wildlife/livestock sampling sites in high-risk populations to subsequently assess viral sharing and develop targets for mitigating interventions to disrupt exposure, amplification, and spread.

- As a proof-of-concept for longitudinal surveillance of influenza viruses and the integration of pathogens beyond influenza into existing human and animal surveillance systems, coordinated with WHO and FAO to develop a pilot project in Viet Nam (pending local approvals and support) at existing SARI site(s) and areas with intensive animal production and animal value chain, including wildlife farms.
- Analyzed data from PREDICT-1 to estimate sample sizes needed to detect shedding of target viruses to guide planning and budgeting for surveillance activities.
- Conducted epidemiologic and ecological analyses of host species-level datasets on past viral spillover risk and species occurrence in value chains to prioritize wildlife and livestock host taxa for surveillance and presented data for integration into surveillance plans at partner-wide meetings.
- Refined all field sample collection protocols for targeted hosts and taxonomic groups to optimize RNA virus detection and sample transport, and worked with global and in country field and lab teams to implement changes.
- Established uniform guidelines for best practices on geographic precision of sample location data for sharing of information in public databases (e.g., HealthMap and GenBank), reports, and publications.
- Developed master protocol for human subjects research involved in biological sampling and surveys and submitted to UC Davis Internal Review Board to ensure best practices, protection of privacy for consenting individuals, and minimal risk for all activities.
- Obtained or renewed national and local permits for animal sampling in 13 countries including Bangladesh, Cambodia, China, Nepal, Malaysia, Thailand, Viet Nam, Cameroon, Democratic Republic of Congo, Republic of Congo, Rwanda, Tanzania, and Uganda.
- Began animal sampling activities targeting high-risk wildlife taxa in 12 countries including Bangladesh, Cambodia, China, Nepal, Malaysia, Thailand, Viet Nam, Cameroon, Democratic Republic of Congo, Republic of Congo, Rwanda, and Uganda.

Activity 2.2. Characterizing Risk

- Conducted Modeling and Analytics (M&A) team planning meetings and developed workplan to prioritize activities and overarching goals.
- Finalized “Outbreak Scenario” models and developed 2-page summaries for: GB virus (Bangladesh); MERS-like coronavirus (spread from slaughtering imported camels – Section 6.4); Hantavirus (Yunnan, China); Simian Foamy Virus (Cameroon); Novel bat Paramyxovirus (Indonesia); MERS-like Coronavirus from bat guano (Thailand).

- Completed MERS-epizone spatial spillover risk model, combining geographic range of potential bat reservoir host and national data on dromedary camel densities.
- Developed a preliminary SIR model for circulation of MERS-CoV within camel populations based on herd size, connectivity, and market structure to guide surveillance of camel populations and forecast the potential effect of livestock intensification on changes in MERS disease dynamics in Africa and the Middle East.
- Conducted statistical analysis of demographic factors (e.g., number of cases at detection, regional population density) for historical Ebola virus outbreaks to identify any unique factors that may have contributed to unique spread of West Africa outbreak.
- Conducted spatial analysis of PREDICT-1 global site data (including spatial extent of named sites, pairwise distances between sites per country, and frequency of sampling at each site) to refine strategy for site definitions under PREDICT-2.
- To inform site and interface sampling targets within epizones, conducted epidemiologic analysis of test results to date to evaluate high-risk wildlife hosts and common animal-human interfaces along with sample types and animal conditions yielding positive samples for viral families tested.
- Identified zoonotic viruses reported in wildlife and domestic animal species to date and evaluated the relationship between species abundance and species propensity for hosting a higher number of zoonotic viruses, while adjusting for data deficient animal species.
- Examined changes in global airline travel volume and international connectivity when travel sanctions are put in place using West Africa Ebola virus outbreak as case study.
- Conducted economic analyses of specific intervention strategies enacted or proposed for West Africa Ebola outbreak.
- Developed natural language processing tool (PubCrawler) to map fine-scale research effort globally (bias measure) for EID risk analyses.
- Finalized and published new method that ranks high-risk interfaces and key ecological and epidemiological processes influencing the evolution, spillover, amplification, and spread of viral threats (Section 5: Johnson et al., 2015).
- Modeled and mapped the predicted vs. observed number of zoonotic viruses for all mammals globally to identify areas and mammalian communities of greatest value for zoonotic virus discovery (manuscript in preparation).
- Revised global analyses for characterizing ecological risk factors and areas for zoonotic EID spillover risk (Hotspots II); manuscript drafted and publication pending.
- Initiated stand-alone Hotspots II in order to identify the specific drivers of emerging infectious diseases in Africa and to define the role of livestock intensification (cattle, pigs and chickens) for the project Africa Livestock 2050.

- Initiated collaboration with FAO (Africa Livestock 2050) to share data and develop SIR and spatial models to analyze different agricultural intensification scenarios for Africa.

Activity 2.3. Viral detection and discovery, and longitudinal monitoring of viruses to track changes in geographic and host distribution, genetic sequences, transmissibility, infectivity, and viral evolution

- Refined laboratory methods for RNA extraction to align with PREDICT focus on RNA viruses.
- Completed development and optimization of new cPCR protocols for improved detection of Filo, Flavi, and Bunya viruses; cPCR assays for Hepaci, Pegi, and Parvo viruses still in development.
- Developed guidelines for prioritization of sample selection for PREDICT-2 testing.
- Initiated pilot testing of cPCR assays for bacterial detection.
- Completed full genome sequence of a MERS-like coronavirus found in Uganda; performed 3-D structural analysis of the spike protein and noted changes that have consequences for host species range.
- Completed full genome sequence of three bat influenza viruses from Bolivia and Brazil; genetic analysis suggests one of these may be a new subtype.
- Identified PREDICT Influenza and Corona viruses for deep sequencing in order to develop primer sets for PCR characterization of genomes in country.
- Initiated high throughput sequencing of select coronavirus (five out of 18) for genome completion, sequencing completed and data analysis in progress.
- Established a project-wide Laboratory Implementation Team as a forum to resolve problems to ensure consistency for sample handling, testing, and viral detection, as well as to provide feedback and information to labs.
- Published a study examining the global diversity and mutation rates of Influenza A viruses to identify re-combination hotspots and inform on surveillance (Section 5: Rejmanek et al., 2015).
- Published a study examining the viral diversity in macaques in Bangladesh; discovered 184 viruses and conducted ecological analyses to show that viral communities are structured in largely predictable ways (Section 5: Anthony et al., 2015).

Activity 2.4 Advancing pathogen characterization through refinement and development of new diagnostic tools and mainstreaming testing protocols

- In Bangladesh, introduced Virome Capture Sequencing (VirCapSeq-VERT) for pathogen discovery in human samples from cases with acute encephalitis and respiratory illness.
- Initiated comparison of viral detection technologies used for testing samples from humans with traditional PCR for specific pathogens with PREDICT cPCR protocols in Thailand.

- In collaboration with FAO in Indonesia, initiated comparison of viral detection technologies used for testing samples from livestock using traditional PCR for specific pathogens against PREDICT cPCR protocols.
- Initiated discussions with FAO for training of national reference laboratories and sharing of PREDICT viral family protocols.

Activity 2.5. Assisting host country partners in outbreaks

- Engaged EPT partners, including WHO and FAO, at international and regional in-country meetings to build partnerships and increase synergies for outbreak response planning and preparedness.
- Engaged host country governments and relevant national ministries to provide guidance on PREDICT's availability for assistance in outbreak investigations and response activities during outbreaks with undiagnosed causes of illness in humans.
- Worked with EPT partners to compile global and in-country staff contact information to facilitate communication and coordination in the event of an outbreak.
- Upon request from host country governments, assisted with outbreak investigations in five countries for ongoing preparedness and training purposes by providing expertise, and when appropriate field assistance for animal sampling in DRC, Rwanda, Uganda, and Malaysia, and laboratory support for an as yet unidentified cause of disease in humans Thailand.

Objective 3: Characterizing Behavioral Risk

Investigate the correlation of human behavior and zoonotic disease risk to understand the behavioral mechanisms of high-risk pathways for disease emergence and spread; identify potential control points and behavior change options.

Activity 3.1. Standardizing approaches to study human behavioral risk

- Completed analysis of >1000 household-level Deep Forest Human Contact surveys from three countries (Uganda, Brazil, and Malaysia) to characterize human-animal contact across a land-use gradient and by demography. Results from this survey will indicate how human-animal contact, a fundamental but poorly quantified measure in disease systems, might vary with land-use practices and intensity of disturbance, while all data from Deep Forest will be used to inform the likelihood of EID spillover along a pristine-to-disturbed gradient, and subsequently provide an index of risk that can be applied across different landscapes.
- Established the project-wide Behavioral Risk team.

- Collated and reviewed all PREDICT and PREVENT protocols, guides, and reference materials relating to behavioral research to prevent duplication of effort.
- Standardized qualitative behavioral risk research data collection guides, protocols, and training materials developed and pilot tested in live animal markets in the US and China.
- Coordinated with consortium operational teams in the planning and development of standardized implementation activities for the Human Questionnaire (Section 6.1 and 6.2) and to integrate behavioral risk data collection into biological data collection protocols and training materials (Section 6.3).
- Developed globally-standardized qualitative research activities and obtained ethical approval for conduct of activities from the UC Davis IRB in May 2015 (Section 6.3).
- Identified priority countries for qualitative behavioral risk research: Bangladesh, Cameroon, China, DRC, Indonesia, and Uganda.
- Established and/or re-engaged partnerships in all priority countries plus Malaysia for the coordination of observational behavioral research. Conducted trainings in five of six priority countries targeted for behavioral risk research in Year 1 (China, Bangladesh, Uganda, Cameroon, and DRC) and following local IRB approval, initiated data collection in Bangladesh, China, and DRC. Activities will commence in additional countries in Year 2 beginning with Cameroon, Indonesia, and Uganda, with the addition of Malaysia and Viet Nam, as Year 2 priority countries.
- Global team conducted initial site visits with observational research in Bangladesh, China, Indonesia, Egypt, Cameroon, and DRC to identify and evaluate potential data collection sites.
- Initiated preliminary data analysis on available qualitative observational field notes, focus group discussions, and ethnographic interviews.
- Acquired reports and databases from PREVENT documenting longitudinal wildlife market conditions and practices in the Republic of Congo and Democratic Republic of Congo and initiated plans to design additional behavioral risk investigations into the wildlife value chain in these countries that will compliment evolving surveillance and sampling of hunted, traded, and consumed wildlife.
- Prioritized additional countries and initiated planning for further qualitative studies in Nepal, Viet Nam, Republic of Congo, Tanzania, Guinea, Liberia, and Sierra Leone.

Objective 4: Improving Global Surveillance Networks

Strengthen internal data storage and sharing platforms to improve the ease of collection, synthesis, storage, access, and dissemination of relevant animal and human, spatially explicit epidemiological and ecological data.

Activity 4.1. Standardizing data collection

- Fostered consortium-wide collaboration among PREDICT behavioral, laboratory, surveillance, and information management teams to develop revamped and standardized site and event characterization protocols and data collection tools for animals and specimens (Section 6.2 for more information).
- As part of data collection tool development, created 10 specific modules as part of the Human Questionnaire (Section 6.1) to collect detailed data on various key transmission interfaces including but not limited to: animal production facilities, wildlife markets and restaurants, and extractive industry; in addition, developed data collection protocols and tools for animals and specimens and protocols for collecting quantitative behavioral risk data at key interfaces.
- Created a platform-independent data collection application for the Emerging Infectious Disease Information Technology Hub (EIDITH: PREDICT's internal information management system) to facilitate collection of all site, event, animal, and specimen data. The new EIDITH application can run on any tablet or computer and has offline capability, enabling data collection without Internet access and with automated synching with the EIDITH server once Internet connectivity is restored (Section 6.2).
- Adapted the EIDITH database structure to accommodate the new site and event characterization data described above and established links to transfer data between all data collection apps and the EIDITH platform.
- Created tables to hold and display all data from the newly minted apps.
- Using optical character recognition technology, developed a system built on standardized paper forms ("bubble forms" – Section 6.2) and scanners to allow collection and import of data directly to EIDITH when the use of the electronic app for tablets, mobile phones, or laptops is not practical or feasible. This system mirrors the data collection application and provides a functional alternative to electronic data collection while maintaining the inherent standardization benefits.
- Developed software to transfer data from the optical character recognition application (the "bubble form" app) into EIDITH.
- Using the same technology as the EIDITH data collection applications, a platform-independent application with offline capability and its bubble form analog were also created to collect data on PREDICT training activities to enable greater oversight and monitoring of the status of trained personnel for country coordinators and global leads (Section 6.2).

Activity 4.2. Synthesizing global data

- Initiated preliminary discussions on the development of potential uses for the planned global respiratory database.

Activity 4.3. Disseminating global data

- Continued to distribute PREDICT surveillance and digital disease detection data through the open access public site, http://data.predict.global.
- Continued interpretation of PREDICT sequences and provided government result reports.
- Began to submit PREDICT sequences to the Genbank Database.

Objective 5: Validating One Health Approaches

Conduct a systematic and dedicated effort to validate and evaluate the utility of One Health approaches using all available evidence.

Activity 5.1. Promoting policies and practices that reduce the risk of virus evolution, spillover, amplification, and spread

- Developed a structural framework for comparing outcomes of One Health approaches versus other approaches to outbreaks.
- Developed the outline for One Health case studies booklet and selected initial cases to draft. The case studies will also be utilized to inform on One Health best practices and to share with other EPT-2 projects.
- Developed draft of the country-level One Health data collection form that will be used for systematic evaluation of One Health approaches in EPT-2 countries. The draft data collection form includes temporal, economic, health burden, and policy indicators that can be used to assess cost-effectiveness and inform national and international policy actions.
- Identified data parameters for prospective collection by EPT-2 partners to allow for expanded and consistent inputs and precision in cost-effectiveness analysis of One Health approaches.
- Completed a systematic literature review of quantitative and qualitative outcomes reported in One Health articles.
- Established collaboration with the Network for the Evaluation of One Health for sharing of One Health case studies and cost-effectiveness evaluation approaches.
- Published paper (Section 5: Pike et al., 2014) analyzing the cost-effectiveness of implementing a One Health approach to mitigate pandemics.
- Published paper with colleagues from WHO, OIE, and other partners on a cost-effective global strategy for monitoring avian influenza viral diversity (Section 5: Machalaba et al., 2015).
- Published paper on preventive public health systems, highlighting PREDICT approaches to sentinel monitoring and detection (Section 5: Machalaba and Karesh, 2015).

- Published paper with FAO colleagues on policies for mitigating adverse food chain and environment impacts of pharmaceutical residues (PREDICT-adjacent; Section 5: Margalida et al., 2014).
- Liaison appointed to the four-person OFFLU (Network of Expertise on Animal Influenza) Steering Committee and assigned to lead the OFFLU wildlife/wild bird influenza surveillance technical activity, which was established to provide a platform for discussion, coordination, and data sharing between key wildlife experts involved in influenza surveillance and research.
- Highlighted PREDICT approaches in NIH, GHSA, and OIE meetings, including a keynote address for the Global Conference on Biological Threat Reduction.
- Worked with WHO and FAO to produce guidance documents on Ebola transmission via food and animal contact during the West Africa outbreak.
- Liaison served on the WHO Expert Roster on zoonoses.
- Liaison appointed to the “Towards a Safer World” Advisory Board.

Activity 5.2. Improving cross-sectoral collaboration and coordination with EPT-2 partners

- Held quarterly coordination calls with P&R and OHW.
- Compiled and shared list of existing One Health platforms by country with P&R.
- Generated an activity list to support the One Health Workforce workplan, including training, One Health case studies, protocols, and technical advising resources.
- Held coordination meetings and calls with FAO and initiated discussion with CDC on EPT-2 scope of work.
- Began discussing collaboration with The World Bank for a follow-up phase of their “People, Pathogens, and Our Planet” report on the economics of One Health, as well as broad areas of integration on policy-oriented outputs of One Health cost-effectiveness analysis.
- With P&R, reviewed the World Bank’s draft environmental and social safeguards and began developing proposed edits consistent with EPT-2 best practices.
- Developed recommended priority sites for targeted influenza surveillance with FAO and produced report for USAID.
- Developed a guidance document for the OIE as a resource to assist member countries in implementing wildlife disease surveillance. The document includes a budget planning template and highlights the importance of capacity for information sharing.
- Provided input on One Health approaches to emerging infectious disease prevention at the UNEP Convention on Biological Diversity 12th Conference of the Parties in October 2014 (non-PREDICT). Parties recognized “the value of One Health” in their official decision on biodiversity and human health.

- Coordinated infectious disease chapter of the WHO-CBD publication "Connecting Global Priorities: Biodiversity and Human Health, a State of Knowledge Review", highlighting PREDICT as a One Health approach.
- Provided an overview of EPT-2 and an update on emerging disease issues at the Steering Committee meeting of the Global Framework for the Progressive Control of Transboundary Animal Diseases meeting, organized by the FAO and OIE, in October 2014.
- Shared viral family screening protocols with external collaborators, including the Laboratory of One Health Research at Duke-NUS Graduate Medical School Singapore and the University of Pretoria in South Africa.
- Advised FAO on EBOV/filovirus tests and shared PREDICT-2 protocols.

Objective 6: Strengthening Capacity

Add depth and scope to transdisciplinary One Health platforms, thereby strengthening surveillance system capacities; support the training of the next generation of the One Health professionals through coordinated activities with EPT and inter-agency partners.

Activity 6.1. Systems approach to capacity building for wildlife, livestock, and human surveillance

- Conducted monthly Capacity Team coordination teleconference meetings.
- Continued to provide technical support to in-country laboratories.
- Established baseline serologic capacity in collaborating laboratories to support the development of appropriate technologies for PREDICT activities.
- Piloted online platforms with country teams in Africa and Asia to facilitate distance learning and conduct trainings related to new surveillance and information management protocols and data collection tools.
- Revised sample collection guidelines for incorporation into updated field sampling protocols for all taxa and new protocols for human sampling.
- Updated field sampling protocols and training guides for wildlife (bats, rodents, primates), livestock (camels, cattle, small ruminants), and humans, as well as for environmental sampling.
- Updated laboratory safety training modules (in particular to address chemical handling and waste as a result of protocol changes).
- Created new training guides and associated materials (e.g., quizzes, training instruction tools) needed for new project activities in the behavioral sciences (qualitative research to evaluate behavioral risk practices) and for spatial analysis to foster enhanced spatial mapping skills.
- Performed a review of outbreak-related protocols for updating and coordination across partners and field activities and began revising the guide for in order to provide best achievable assistance during zoonotic disease outbreaks.

- Began the design and compilation of all existing and in-development PREDICT training guides, protocols, and capacity strengthening resources into an e-Book intended for PREDICT staff and implementing personnel. The team completed initial sections on: ethical considerations; permissions, permits, and protocols; general field sampling station set-up; safe animal capture and sampling; general data collection; safe disposal of carcasses and infectious material; qualitative research and data collection for behavioral risk investigations; implementing a cold chain for safe sample transport and storage; basic laboratory safety; data policies and plans and data collection for surveillance; biosafety and PPE use; emergency preparedness; cultural considerations for international work; preventing sexual harassment; and spatial analysis using QGIS. The e-Book will be a living document under continual review and adaptation with a completed first edition available online in Year 2.
- Completed an annual capacity tracking activity using Country Coordinators in a key informant approach to guide PREDICT strategic planning.
- Began distribution of PREDICT training resources to participating countries and partners, as needed, to facilitate capacity strengthening in country.

Activity 6.2. Coordinating capacity development across EPT projects

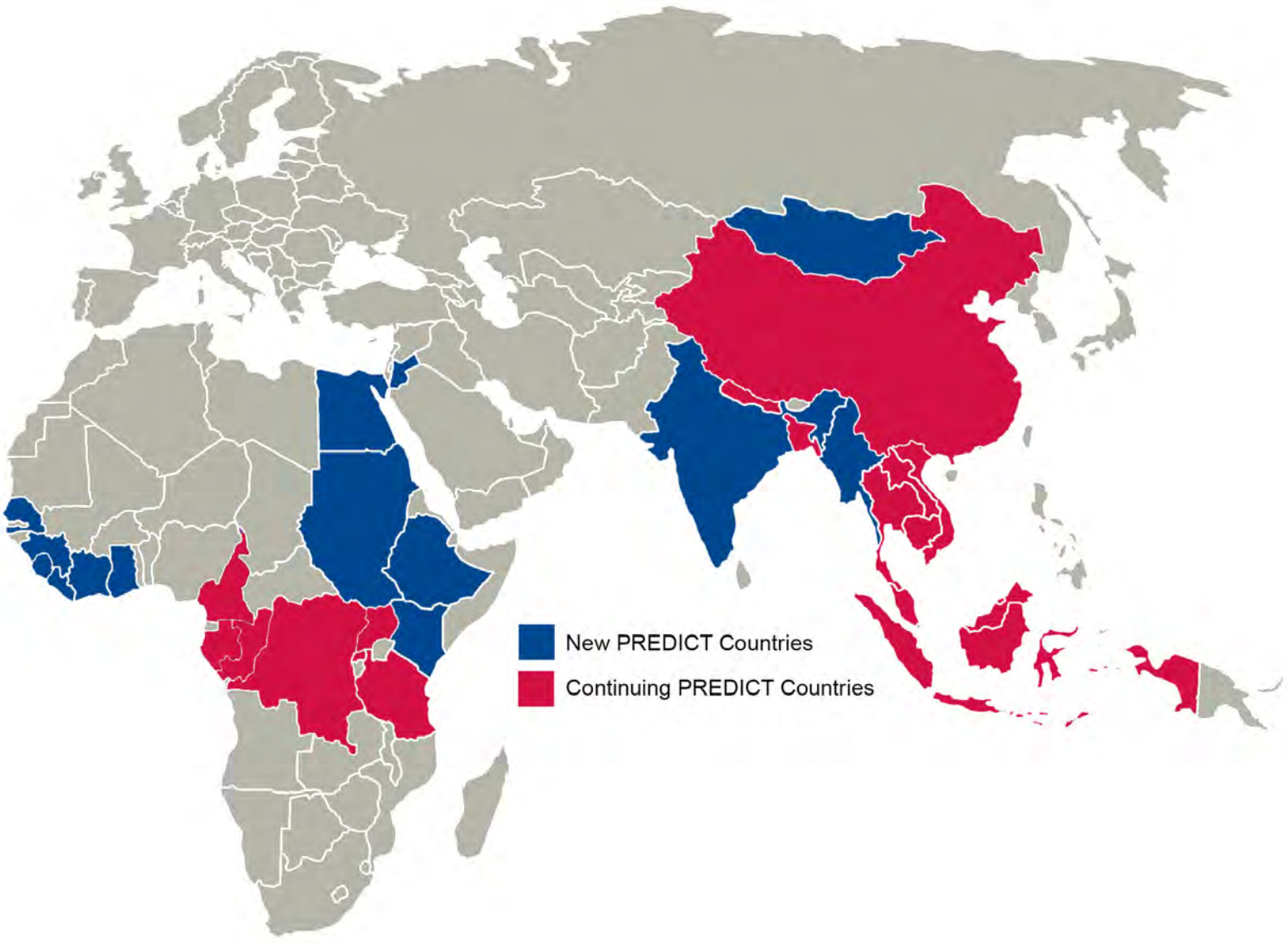
- Participated in discussions with partner groups about timelines and processes for coordination across EPT projects and sharing of capacity strengthening resources including protocols, experiences, and training opportunities:
  - FAO for training of national reference laboratories for potential utilization of PREDICT viral family protocols;
  - WHO for sharing of PREDICT viral family protocols.

Objective 7: Assisting Organization of USAID PIOET Annual Data Review Meetings

In close coordination with USAID and other EPT-2 projects and partners (including FAO, CDC, WHO, etc.), organize annual data reviews to optimize and refine ongoing and future activities.

- USAID requested that first data review meeting occur in 2016.

III. COUNTRY REPORTS



CAMEROON

Highlights and Success Stories:

- PREDICT, together with representatives of the Food and Agriculture Organization of the United Nations (FAO), Preparedness & Response (P&R), One Health Workforce (OHW), and USAID, was received by the Prime Minister of Cameroon to discuss the Emerging Pandemic Threats-2 (EPT-2) program and disease emergence in Cameroon.
- At the invitation of the Minister of Livestock, Fisheries and Animal Industries, PREDICT nominated the Field Coordinator to be a representative to the Cameroon Animal Disease Surveillance Network (RESCAM).

Summary of Surveillance and Field Activities for the Period Oct. 2014-Sept. 2015:

- Conducted site reconnaissance visits in South Region of Cameroon where hunting and selling of wild animals takes place and where hydroelectric and rubber plantation development is ongoing. Through this process, the team revised sampling focus areas and refined site selection. In addition, some sampling was conducted to determine suitability of the sites for sampling. A total of 1,085 samples were collected from 207 animals, including 96 rodents, 55 bats, and 55 hunted animals.
- Coordinated joint surveillance activities with central and local governmental ministry staff responsible for wildlife and livestock.
- Initiated site scoping visits in villages near two hydroelectric dams under development and within an area of oil palm plantation expansion.
- Liaised with officials from agroindustrial company Sud Cameroun Hevea SA (SUDCAM), a rubber producing company currently expanding plantations in Cameroon, to discuss opportunities for operational alignment and assessed the rubber expansion zone as a possible new surveillance site.
- Provided key support to the development of the pilot human behavioral study protocol; initiated contact with local partners to facilitate implementation of this pilot.

Summary of Laboratory Development/Testing for the Period Oct. 2014-Sept. 2015:

- Successfully tested an Ebola real-time PCR assay using a synthesized positive control.
- Performed 3,213 PCR tests for Influenza virus, Paramyxovirus, and Coronavirus families on 1,619 samples from 1,181 animals, and shipped 80 samples to GATC Biotech (Germany, a commercial sequencing company) for sequencing.
- Repeated analyses on two pools of specimens from PREDICT-1, dividing the pool to determine which specimen was positive for a novel Arterivirus (pool of three rodent samples) and a novel Icavirus (pool of two bat samples).
- Performed deep sequencing to further characterize a rodent pox virus identified during PREDICT-1; awaiting results to determine future steps.

- Collected and tested post-mortem specimens from a patas monkey and a baboon from Limbe Wildlife Centre that died following respiratory difficulties using viral family protocols; all samples were negative, and no further testing is planned.
- Visited BOCOM International, the contracted waste removal company, to ensure proper management of hazardous waste.
- Conducted a comprehensive review of all previous PREDICT laboratory analyses by sample type to characterize gaps and future testing needs. Through this process a series of 945 samples that had not been tested for Influenzaviruses, Coronaviruses, and Paramyxoviruses were identified and 1,386 PCR tests were done.

Summary of Stakeholder Engagement and Partner Coordination for the Period Oct. 2014-Sept. 2015:

- Received approval for the publication of the remaining PREDICT-1 results from the Ministry of Defense (MINDEF), Ministry of Wildlife and Forestry (MINFOF), and the Ministry of Environment (MINEPDED).
- Contributed substantively to weekly epidemiological meetings organized by the Ministry of Health (MoH) and briefed the MoH on novel arteriviruses and henipah virus research.
- Engaged visiting P&R team to discuss EPT-2 coordination and joint P&R-PREDICT activities.
- Attended the P&R and National Zoonosis Program (NZP) meetings to discuss the P&R workplan in Cameroon in June.
- Met the Permanent Secretary of the NZP to evaluate the Program workplan and identify opportunities for alignment with PREDICT activities in July.
- Hosted a meeting of USAID EPT-2 (Africa and Cameroon) with PREDICT, OHW, P&R, and FAO representatives to identify alignments between EPT-2 activities and the NZP workplan in August.
- Together with EPT-2 partners (PREDICT staff; USAID staff from DC, Nairobi, and Yaounde; and staff from P&R and OHW), met with NZP staff (1 September 2015) and the NZP Technical Committee (2 September 2015) to present proposed EPT-2 activities.
- Participated in the FAO-led meetings of the Regional Network of National Epidemiosurveillance Systems for HPAI and Other Priority Animal Diseases in West Africa (RESEPI) and the West and Central Africa Veterinary Laboratory Network for Avian Influenza and other Transboundary Diseases (RESOLAB) for Chief Veterinary Officers (CVOs) and laboratory directors from Central Africa.
- Attended the Cameroon One Health partner summit in January with WHO; MoH; Ministry of Livestock, Fisheries, and Animal Industries (MINEPIA); MINEPDED; MINFOF; NZP; and Centre Pasteur at WHO and discussed a subset of PREDICT's scoping plans, presented results from PREDICT-1, and engaged in strategizing critical activities.
- Supported the USAID team in preparing, organizing, and attending the May 2015 GHSA meetings at the ministries of environment, health, wildlife, and livestock.

- Engaged DTRA representatives and contractors undertaking a needs assessment in Cameroon to provide background information and documents and contacts. The finalized needs assessment is an internal USG document.
- Assisted WHO and MoH in the completion of an Ebola readiness assessment.
- Met with the International Atomic Energy Association (IAEA)/FAO joint office in March 2015 to discuss potential collaborations in biosafety & security, Ebola preparedness, and Ebola reservoir surveillance.
- Held discussions with the National Veterinary Laboratory of Cameroon (Laboratoire National Vétérinaire du Cameroun; LANAVET) and the Director of the Institute for Novel and Emerging Infectious Diseases at the Friedrich-Loeffler-Institute (FLI) about potential collaborations on Rift Valley Fever and Henipa viruses.

Other Activities this Period*:*

- Provided technical support and training to the PREDICT Republic of Congo (RoC) team for the initiation of field surveillance activities in RoC.
- Briefed the Director of Veterinary Services and the Director of the Medical and Medicinal Plant Institute of the Ministry of Research on a recent Henipavirus publication.
- Shared a manuscript on new Arteriviruses with the Government of Cameroon (GoC), submitted the manuscript to the Archives of Virology, and shared a Taxonomic Proposal with the International Committee on Taxonomy of Viruses (ICTV).
- Provided shipping materials to CDC Cameron to facilitate export of a monkeypox sample (from the June 2014 outbreak) to the US National Institutes of Health (NIH), to permit additional characterization.
- Provided guidance to CDC Cameroon (Field Epidemiology & Laboratory Training Program) on a draft MoH document detailing roles of Ebola rapid intervention teams.
- Assisted MoH, WHO, and Pasteur Center Cameroon (CPC) and led two training sessions on personal protective equipment (PPE) during two Hemorrhagic Fever Virus workshops in October 2014 and January 2015 targeting physicians and laboratory technicians from 10 different regions of Cameroon.
- Provided technical assistance through presentations on PPE use and supervision of Ebola case simulations during a GoC, CDC, and Public Health England initiative for training of Ebola rapid intervention teams.
- Provided technical assistance for DTRA and CDC-supported emergency operations training in December 2014 and a P&R-supported Ebola scenario workshop in November 2014.
- Attended the EECAS (Economic Community of Central African States) meeting in February 2015 and discussed strategies to fight or prevent the Ebola virus epidemic.
- Provided advice to Limbe Wildlife Centre, Cameroon management staff on setting up a independent laboratory (non-PREDICT) at the centre for onsite animal testing and for recruitment of a lab manager.

- Presented on Ebola reservoirs and origins of outbreaks for the Cameroon Biological Safety Association at the Ministry of Livestock.

Training Summary

Topic	Total # Trained*	# Women Trained	# PREDICT Staff Trained	# Government Ministry or Lab Staff Trained	# Students Trained
Behavior Risk	1	1	1	0	0
Lab Safety	5	1	5	0	0
Information Management	4	1	4	0	0
Ethics	1	0	0	0	0
Grand total	6	1	6	0	0

**Multiple individuals cross-trained in various topics.*

COTE D'IVOIRE

Highlights and Success Stories:

- Finalized work plans and surveillance strategy, including timeline for implementation.
- Identified Institut Pasteur de Côte d'Ivoire (IPCI) and the Laboratoire de Pathologie Animale et Aviaire de Bingerville (LANADA-Bingerville) as key potential collaborators.

Summary of Surveillance and Field Activities for the Period Oct. 2014-Sept. 2015:

- No surveillance or field activities conducted in Year 1.

Summary of Laboratory Development/Testing for the Period Oct. 2014-Sept. 2015:

- No laboratory testing conducted in Year 1.

Summary of Stakeholder Engagement and Partner Coordination for the Period Oct. 2014-Sept. 2015:

- Participated in the GHSA technical workshop in Abidjan from July 21-22, 2015 along with US Government (USG) teams from USAID (P&R, FAO), Department of Defense, the US Centers for Disease Control and Prevention (CDC), and other key in-country partners from various research institutions and governmental ministries.
- Organized a workshop at IPCI in Abidjan in September 2015 attended by collaborators from IPCI and LANADA-Bingerville, and reviewed program objectives and strategies and finalized the implementation plan.

Other Activities this Period*:*

- Held meetings with regional PREDICT teams in Cameroon, RoC, and DRC to synergize workplans and coordinate a regional approach to surveillance.

Training Summary

Topic	Total # Trained	# Women Trained	# PREDICT Staff Trained	# Government Ministry or Lab Staff Trained	# Students Trained
PREDICT Basic Training	15	6	0	15	0

DEMOCRATIC REPUBLIC OF CONGO (DRC)

Highlights and Success Stories:

- Received approval from the Government of the DR Congo to release PREDICT-1 laboratory findings to the scientific community.
- Prepared three genome sequences of the Ebola virus detected during the Boende Ebola Outbreak in DRC (2014) in collaboration with University of California San Francisco (UCSF) lab and submitted the sequences to GenBank (KP271018-KP271019-KP271020). At the time of the outbreak, it was not clear if the Boende outbreak was related to the outbreak in West Africa. By releasing these sequences publicly, PREDICT was able to demonstrate that they were part of a separate outbreak of Ebola virus.
- Upon request from the DRC Ministry of Health (MoH), organized a trip to Boende in the aftermath of the Ebola Virus Disease (EVD) outbreak to collect wildlife specimens for filovirus testing; collected a total of 255 samples (from 41 bats and 2 rodents).
- Received a nomination (Country Coordinator) from the DRC Minister of Health to be a member of the national team of first responders in case of chemical, biological, radiological, and nuclear (CBRN) hazard and contributed to the preparation of the national action plan for CBRN threats.
- Designated by the North Kivu Provincial Division of Health as a standing invitee to its bi-weekly epidemio-surveillance meetings in Goma, where all human disease cases in the Province are reported and discussed.
- Received the express support of the North Kivu Provincial Inspector of Human Health to work in two health zones around Virunga National Park (Bunagana and Rwanguba), enabling Virunga National Park (PNVi) to assign its head nurse to visit 14 community health centres surrounding the Mikeno Sector of PNVi (Bunagana, Bugusa, Kabonero, Shangi, Rutsiro, Kabaya, Kabindi, Tanda, Kazuba, Rugari , Kakomero, Kingarama Gasizi and Kibumba), to identify centres for collaboration, and to assess their capacity to store samples and participate in human health surveillance.

Summary of Surveillance and Field Activities for the Period Oct. 2014-Sept. 2015:

- Granted use of and access to United Nations and other humanitarian flights for PREDICT field surveillance trips.
- Revised sampling sites in accordance with new surveillance guidance.
- Obtained key in-country permits for the conduct of PREDICT activities, including a two-year wildlife sample collection permit from the provincial Ministry of Environment of Kongo-Central (formally Bas-Congo), a one-year wildlife sample collection permit from the Provincial Ministry of Environment of Kinshasa, and Institutional Review Board (IRB) approval for the behavioral pilot study.
- Trained 13 field investigators from the Kinshasa School of Public Health (KSPH) and other in-country institutions and the PREDICT Country Coordinator on qualitative data collection methods and the PREDICT approach to behavioral risk investigations.

- Conducted a field pilot and training (two focus groups and nine ethnographic interviews) using the behavioral data collection tools at the sanctuary of bonobos in Kinshasa.
- Completed a field trip in the Kongo-Central Province and visited five sites including: Kinzau-Mvuete, a city where bush meat vendors sell newly slaughtered wild animals; Lukula, a location with large-scale deforestation for timber, hunting, and bushmeat markets/restuartants and large palm oil, coffee, and rubber plantations; Mangala, the site of the 2009 hemorrhagic fever of unknown origin (FUO) occurrence later identified by PREDICT as having been caused by Bas Congo virus; Inga, site of the DRC's main electrical dam (currently planned for expansion) and an area in which bats ultimately destined for restaurants and markets in Kinshasa and Brazzaville are hunted; and Zongo, a tourist destination known for its waterfalls, where people hunt bushmeat that is sold to tourists and is sent to Kinshasa and other cities for sale in markets and restaurants.
- During the Kongo-Central Province field trip, sampled wildlife (bats and rodents) and collected behavioral data, conducting 39 ethnographic interviews and organizing five focus groups.
- Transcribed all recordings from the behavioral pilot (focus groups and ethnographic interviews) and from Kongo-Central field visits and translated all data collected in the local languages into French.
- Supported the global team by transcribing all behavioral and human questionnaires used in the behavioral pilot study into French, to be used by all PREDICT French-speaking countries.
- Investigated a respiratory disease outbreak in a human-habituated group of mountain gorillas in PNVi at the park's request; observed 24 gorillas with clinical signs (coughing and anorexia); opportunistically collected fecal samples from 14 animals; samples to be shipped to INRB for viral family testing in Year 2.
- Collected samples from a captive mountain gorilla in PNVi, previously confiscated from poachers, that was exhibiting signs of gastrointestinal malaise; samples to be shipped to INRB for viral family testing in Year 2.
- Responded to a request from PNVi to obtain and test samples from baboons raiding park headquarters and Rumangabo village and in some cases severely biting people; while human surveillance protocols are pending, PREDICT is working with PNVi on sample collection and will work with local health centres to obtain samples from people bitten by baboons at a later date.
- Responded to request to support an investigation into a respiratory disease outbreak affecting 26 of 42 captive chimpanzees held at the Lwiro Wildlife Rehabilitation Centre, located adjacent to Kahuzi-Biega National Park in South Kivu province; opportunistically collected blood and swabs from four sick animals with close human contact; samples from one primate shipped to INRB for viral family testing; additional samples to be shipped to INRB for viral family testing in Year 2.

Summary of Laboratory Development/Testing for the Period Oct. 2014-Sept. 2015:

- Expanded lab operations with additional space at the Institut National de Recherche Biological (INRB), allowing separation of pre- and post-PCR activities, reducing the risk of contamination.
- Tested samples collected during PREDICT-1 for Coronavirus, Polyomavirus, Enterovirus, Herpesvirus, Adenovirus, and SFV; all results were entered to the EIDITH database.
- Performed follow-up testing and sequencing to confirm results on samples collected and tested in PREDICT-1, including samples for speciation collected in DRC (194 from NHP and 44 from rodents) and ROC (36 from NHP and 18 from rodents) for better identification and phylogenetic placement of the virus sequences.
- Improved laboratory operations through the introduction of cryo-resistant labels and a bar code scanner.
- Travelled to Nanaimo, Canada (Laboratory Manager) for training on sequence analysis.
- Reviewed and analyzed new test interpretations from the EIDITH team.
- Submitted samples from a captive chimpanzee showing generalized chronic but severe clinical signs of disease to INRB for viral family testing; results pending.
- Assessed power availability and cold-chain capacity at 14 different human health centres surrounding PNVi, In preparation for future human sampling, determining that none had electricity but 10 had kerosene-fueld refrigerators with battery back-up.
- Participated in a WHO-organized training workshop in Brazzaville on safe shipping of biological materials.

Summary of Stakeholder Engagement and Partner Coordination for the Period Oct. 2014-Sept. 2015:

- Aligned partners and stakeholders for PREDICT-2 activities: confirmed in-country collaborations with INRB (laboratory testing) and the Kinshasa School of Public Health (KSPH, behavioral studies); prepared a Memorandum of Understanding (MoU) for collaboration with the Mountain Gorilla Veterinary Project, responsible for implementing PREDICT-2 activities in Eastern Congo; and successfully recruited the former PREVENT DRC Country Coordinator for the behavioral pilot study organized in Kinshasa and Kongo-Central.
- Discussed potential collaboration on biological, behavioral, and ecological risk characterization activities with The Bonobo Sanctuary, the University of Lubumbashi/School of Veterinary Medicine, the Awely Program in Basankusu, Equateur Province, and the Central Veterinary Laboratory.
- Initiated a potential partnership with the University of Graben Faculty of Veterinary Medicine for student training and capacity-building through field training opportunities with PREDICT; invited back to make a full presentation to faculty and students in April 2016.
- Briefed the Provincial Inspector of Human Health (point of contact in DRC for the One Health for Central and East Africa network, or OHCEA) in Goma about

PREDICT (December 1, 2014); currently drafting an MOU for future collaboration at community health centres around PNVi.

- Over the course of Year 1, briefed the Director of Disease Surveillance at the MoH, the Director of Animal Production at the Ministry of Agriculture (MoA), and the North Kivu Provincial Environment Minister in Goma on PREDICT-2 plans and activities.
- Briefed the Laboratory Director for the National Animal Health Diagnostic Laboratory in Goma (responsible for provincial animal agriculture inspection) on the project in December 2014.
- Held quarterly meetings (November 2014, January 2015, and March 2015) with the Director and Chief Park Warden of PNVi and the PNVi health department in Goma and in Rumangabo (park personnel village and site of park headquarters); informed about PREDICT-2 surveillance planning.
- Contributed substantively to the development of training manuals and national Standard Operating Procedures (SOPs) for EVD outbreak response, intended for use in the EVD outbreak in West Africa, in collaboration with WHO, UNICEF, and the DRC MoH.
- Attended four in-country implementing partners meetings organized by the USAID mission. These meetings were held to ensure integration on a number of administrative and programmatic issues across the EPT partners and the USAID mission.
- Attended the PREVENT "restitution" (i.e., project wrap-up) meeting in Kinshasa on 12 June 2015, in which PREVENT provided an overview of their survey of bush meat markets. Information was provided on sources of bushmeat, demographic attributes of consumers, biosecurity in markets, and risk perception among vendors and market administrators. Results will inform future PREDICT bushmeat studies on biological and behavioural risk in DRC.
- Discussed PREDICT-1 results with in-country partners from the World Wildlife Fund (WWF)-PICBO project. PREDICT conducted a joint field trip with WWF, the organization responsible for biodiversity surveillance in northwestern DRC, during PREDICT-1, wherein the team conducted village meetings to share information on zoonotic disease prevention and safe butchering practices.

Other Activities this Period:

- Actively participated in the Boende Ebola Outbreak Laboratory and Research Commission and regularly updated PREDICT on Commission activities.
- Presented a poster (Laboratory Manager) on the clinical complications of human monkeypox at the 63rd Annual ASTMH conference in New Orleans, USA, in November 2014.
- Attended a MoH workshop (Laboratory Manager) to prepare for the trial of a new vaccine to prevent human monkeypox.
- Supported PREDICT partners (Country Coordinator) in the roll-out and implementation of PREDICT-2 in West Africa as part of the team visiting new and potential partners in Cote d'Ivoire and Senegal.

- Participated in the Global Health Security Agenda (GHSA) meeting held in Abidjan (July 2015), to assist in the preparation of an action plan for Cote d'Ivoire.
- Presented on diagnostic characterization during the Boende Ebola outbreak, occurrence of herpes viruses in non-human primates, diagnostic characterization of Enteroviruses in captive chimpanzees, and inclusion of local community members in disease surveillance at the 30th anniversary INRB Conference.
- Received acceptance for two abstracts summarizing PREDICT-1 results submitted to the American Society of Tropical Medicine and Hygiene (ASTMH) 64th Annual Meeting .

Training Summary

Topic	Total # Trained*	# Women Trained	# PREDICT Staff Trained	# Government Ministry or Lab Staff Trained	# Students Trained
Behavior Risk	14	2	2	1	4
Packing and shipping biological samples	56	32	0	56	0
Biosafety, PPE, and Safe animal handling and sampling	2	0	0	2	0
Lab safety	56	32	0	56	0
Viral detection and discovery	7	2	0	7	0
Grand total	**77**	**36**	**2**	**66**	**4**

**Multiple individuals cross-trained in various topics.*

EGYPT

Highlights and Success Stories:

- Established data sharing and communication processes with Egyptian government partners at the Ministry of Agriculture; Ministry of Health; and the Ministry of Higher Education, National Research Center to contribute to disease information reporting systems.
- Efforts to expand and collaborate with EPT partners are under way in order to strengthen data platforms and improve the ease of dissemination of relevant animal, human, epidemiological, and ecological data.

Summary of Surveillance and Field Activities for the Period Oct. 2014-Sept. 2015:

- Developed a surveillance plan in conjunction with the PREDICT global team, focusing on high priority pathways for disease spillover, evolution, amplification, and spread at high contact interfaces among humans, livestock, and wildlife.
- Participated in FAO coordinated livestock, wildlife, and human surveillance planning meeting targeting the camel value chain and MERS virus.
- Explored human biological and behavioral risk factors, including population growth, land-use change, and other drivers of disease emergence, spread, and amplification to help guide surveillance plans.
- To assess disease emergence risk, conducted observational research at potential surveillance sites with Ministry of Agriculture representatives in Aswan at the Birqash Camel Market in Giza and at the Daraw Camel Market and quarantine facilities.

Summary of Laboratory Development/Testing for the Period Oct. 2014-Sept. 2015:

- To date, no laboratories have been engaged; future partner laboratories will conduct viral family testing using project protocols with plans to expand list of assays to include additional viral tests and bacteria.
- At the request of potential partners, provided copies of the PREDICT Sample and Data Sharing Policy.
- Toured potential partner laboratories at the US Naval Medical Research Unit No. 3 (NAMRU-3) and the Ministry of Agriculture and discussed the use of viral family protocols especially for Coronaviruses and Influenza viruses to prioritize MERS and Avian Influenza surveillance.

Summary of Stakeholder Engagement and Partner Coordination for the Period Oct. 2014-Sept. 2015:

- Met with potential in-country government partners at the Ministries of Agriculture, Ministry of Health, and Ministry of Higher Education to introduce the project and

assess interest in collaborative relationships to benefit disease surveillance activities in Egypt.
- Initiated integration of disease surveillance activities to develop ideas and identify projects and/or surveillance sites through meetings with EPT partners including FAO, NAMRU-3, and CDC.
- Distributed the PREDICT-1 Final Report Executive Summary to all potential in-country partners including USAID Egypt.

Other Activities this Period:
- Discussed capacity building needs, particularly concerning laboratory capacity, viral family testing protocols, and wildlife and human surveillance activities.

ETHIOPIA

Highlights and Success Stories:

- Established Addis Ababa University's Aklilu Lemma Institute of Pathobiology (AAU) as the primary implementing partner and identified capacity building and training needs to conduct field and laboratory surveillance activities focused on the animal value chain.
- Liaised with key ministry (Ministry of Health, Ministry of Livestock, and Ministry of Agriculture), US Agency, and in-country GHSA partners including FAO and EPT to coordinate workplans for disease surveillance activities targeting priority human and animal diseases.

Summary of Surveillance and Field Activities for the Period Oct. 2014-Sept. 2015:

- Assessed existing surveillance capacities and evaluated partner and infrastructure gaps for project launch.
- Conducted site visits to the Awash and Afar regions to characterize priority pathways of disease emergence within dromedary camel markets and developed a preliminary surveillance plan focusing on the priority disease pathway animal value chain and risk of viral emergence at the camel-wildlife-human interface.

Summary of Laboratory Development/Testing for the Period Oct. 2014-Sept. 2015:

- Completed preliminary evaluation of partner diagnostic laboratory capacities and networks including AAU and the National Animal Health Disease Investigation Center (NAHDIC).

Summary of Stakeholder Engagement and Partner Coordination for the Period Oct. 2014-Sept. 2015:

- Conducted two scoping visits and held meetings with AAU, NAHDIC, the Ministry of Agriculture, Ministry of Health, Ethiopia Wildlife and Conservation Association, FAO Ethiopia, and USAID/Ethiopia to discuss the project and potential collaborations in human, animal, and livestock disease surveillance.

Other Activities this Period:

- Submitted all required partnership and collaboration agreements to obtain permissions for conducting surveillance activities.

GABON

Highlights and Success Stories:

- Finalized work plans and surveillance strategy, including timeline for implementation.
- Identified the Institut National Supérieur d'Agronomie et de Biotechnologies and the Université des Sciences de la Santé, Libreville as key potential in-country partners.

Summary of Surveillance and Field Activities for the Period Oct. 2014-Sept. 2015:

- No surveillance or field activities conducted in Year 1.

Summary of Laboratory Development/Testing for the Period Oct. 2014-Sept. 2015:

- No laboratory testing conducted in Year 1.

Summary of Stakeholder Engagement and Partner Coordination for the Period Oct. 2014-Sept. 2015:

- Held in-country meetings with potential partners from the Institut National Supérieur d'Agronomie et de Biotechnologies and the Université des Sciences de la Santé, Libreville in May 2015.
- Held teleconference calls with potential in-country partners and the PREDICT Cameroon team to facilitate workplan development.

Other Activities this Period:

- Held meetings with regional PREDICT teams in Cameroon, RoC, and DRC to synergize workplans and coordinate a regional approach to surveillance.

GHANA

Highlights and Success Stories:

- Conducted preliminary scoping activities and identified primary subawardees for PREDICT-Ghana implementation.

Summary of Surveillance and Field Activities for the Period Oct. 2014-Sept. 2015:

- Outlined and shared the PREDICT-Ghana Scope of Work and planned Year 2 activities for operational alignment with prospective and planned partners.
- Identified potential field sampling sites for enhanced surveillance along key disease emergence pathways.
- Identified potential ethical approval bodies for consideration of in-country IRB applications.

Summary of Laboratory Development/Testing for the Period Oct. 2014-Sept. 2015:

- Conducted thorough evaluation of in-country human and animal laboratory capacity at the National Public Health Reference Laboratory (NPHRL; Ministry of Health), Noguchi Memorial Institute Research Laboratory (NMIRL; University of Ghana, Legon), and the Accra Veterinary Laboratory (AVL; Ministry of Food and Agriculture).
- Outlined preliminary plans to conduct PREDICT human sample analysis activities at NMIRL, with training and later implementation (pending facility development) at NPHRL; finalized decisions to implement animal sample analysis at AVL.

Summary of Stakeholder Engagement and Partner Coordination for the Period Oct. 2014-Sept. 2015:

- Traveled to Ghana in July of 2015 and successfully engaged representatives of the Ghana Health Service, Disease Surveillance Department (Ministry of Health), FAO, and the USAID West Africa and Ghana Missions; established additional communications with the Ministry of Health Emergency Operations Centre.
- Initiated subaward proceedings to secure the Accra Veterinary Laboratory with the Wildlife Division of the Forestry Commission as the primary in-country PREDICT coordinating body.
- Solicited and vetted applications for the position of PREDICT-Ghana Country Coordinator.
- Coordinated with USAID, CDC, and FAO on in-country engagement.

GUINEA

Highlights and Success Stories:

- Official engagement delayed due to ongoing Ebola Virus Disease (EVD) outbreak response; no activities were conducted in Year 1.

Summary of Surveillance and Field Activities for the Period Oct. 2014-Sept. 2015:

- No surveillance or field activities were conducted in Year 1.

Summary of Laboratory Development/Testing for the Period Oct. 2014-Sept. 2015:

- No laboratory activities were conducted in Year 1.

Summary of Stakeholder Engagement and Partner Coordination for the Period Oct. 2014-Sept. 2015:

- No stakeholder engagement or partner coordination activities were conducted in Year 1.

Other Activities this Period*:*

- No activities were conducted in Year 1.

KENYA

Highlights and Success Stories:

- Explored partnership opportunities and collaborations with EPT and US agency partners (FAO and US CDC and Department of Defense) and with in-country organizations, including the International Livestock Research Institute (ILRI); Kenya Wildlife Service (KWS); Department of Veterinary Services, Zoonotic Disease Unit (a collaboration between the Kenya Ministry of Agriculture, Livestock and Fisheries and the Ministry of Health); University of Nairobi Department of Veterinary Medicine; Kenya Wildlife Trust (KWT); Institute of Primate Research; and the National Museums of Kenya, Northern Rangelands Trust, Lewa Conservancy, and the International Centre of Insect Physiology and Ecology (ICIPE).

Summary of Surveillance and Field Activities for the Period Oct. 2014-Sept. 2015:

- Identified target locations and interfaces for disease surveillance, specifically, camel value chains in the Turkana/Laikipia Region and local consumption and trade of potential Coronavirus reservoirs in Turkana/Laikipia and Nairobi/Kibera.
- Initiated potential collaboration with ILRI to acquire samples collected from baboons with exposure to humans and camels; plans for implementing PREDICT priority viral family testing, as well as MERS-CoV and serologic testing are planned for Year 2.

Summary of Laboratory Development/Testing for the Period Oct. 2014-Sept. 2015:

- Engaged and established an agreement with the International Livestock Research Institute (ILRI) laboratory for diagnostic testing, beginning with the processing of collected baboon samples for MERS evaluation.
- Also initiated discussions with ILRI to plan for MERS-CoV detection and additional viral family testing.

Summary of Stakeholder Engagement and Partner Coordination for the Period Oct. 2014-Sept. 2015:

- Initiated a search for a country coordinator.

LIBERIA

Highlights and Success Stories:

- Official engagement delayed due to ongoing EVD outbreak response. No activities were conducted in Year 1.

Summary of Surveillance and Field Activities for the Period Oct. 2014-Sept. 2015:

- No surveillance or field activities were conducted in Year 1.

Summary of Laboratory Development/Testing for the Period Oct. 2014-Sept. 2015:

- No laboratory activities were conducted in Year 1.

Summary of Stakeholder Engagement and Partner Coordination for the Period Oct. 2014-Sept. 2015:

- No stakeholder engagement or partner coordination activities were conducted in Year 1.

Other Activities this Period*:*

- No activities were conducted in Year 1.

REPUBLIC OF CONGO

Highlights and Success Stories:

- Signed a Memoradum of Understanding (MoU) on December 10, 2014 with the Directorate of Military Health at the Ministry of Defense granting PREDICT a permanent office in Brazzaville to support the administrative and programmatic management of the project with full-time staff.
- Granted a scientific permit by the Ministry of Forestry Economy and Sustainable Development covering surveillance activities through the entire period of PREDICT-2.
- With support of the PREDICT Cameroon team and a member of the Department of Forest Economy, the PREDICT RoC team participated in a practical training, with an initial session in Brazzaville and then traveled to the Sibiti region of the Lékoumou Department, 300 km northeast of Brazzaville in August 2015. During the training session, 558 samples were collected from bats and small rodents. During this trip, the team received training and technical assistance from the PREDICT Cameroon team in safe animal sampling methods and completed refresher trainings in information management, illustrating the cross-country collaborations that support a broader African cadre for disease response, including Ebola.

Summary of Surveillance and Field Activities for the Period Oct. 2014-Sept. 2015:

- Developed an implementation plan, including an estimated timeline for field and laboratory activities.
- Continued ongoing collaborations with local governmental authorities, stakeholders, and gobal and regional PREDICT teams to collect intelligence for identification of strategic surveillance and sampling locales.
- Obtained country maps indicating areas of extractive industry activity and identified key regions at high risk for disease transmission along human-wildlife interfaces and produced a table detailing the location and importance of biodiversity and the presence or absence of extractive industries to facilitate site selection.
- Identified potential sites for domestic animal and wildlife surveillance based on epidemiological importance, the volume of exploited species available to sample, and shared sites with FAO: these included farms around Brazzaville and Pointe-Noire, the Bouemba market, Boundji, Loudima, Mindouli, and Oyo.

Summary of Laboratory Development/Testing for the Period Oct. 2014-Sept. 2015:

- Renewed the collaboration between the INRB of Kinshasa DRC and the Laboratoire National de Santé Publique (LNSP) of Brazzaville, established during PREDICT-1, to facilitate testing of samples from RoC in DRC; this collaboration was reinstated through letter N°179/MSP/LNSP/DG/14 from the LNSP Director General.

- Continued analysis of data produced in PREDICT-1 with plans to to finalize an article on Coronaviruses currently in development.

Summary of Stakeholder Engagement and Partner Coordination for the Period Oct. 2014-Sept. 2015:

- Together with governmental officials, strengthened communications and established procedures for governmental review and authorization of release and publication of project data.
- In May 2015, provided technical and financial support for the inaugural monthly EPT meeting held under the direction of the International Health Regulations (IHR) Focal Point and in partnership with the General Directorate of Epidemiology and the Fight against Disease (DGELM) and the Directorate of Public Health and Health Promotion (DHPPS). .
- Attended the PREVENT "restitution" (i.e., project wrap-up) meeting in Kinshasa on 12 June 2015, in which PREVENT provided an overview of their survey of bush meat markets. Information was provided on sources of bushmeat, demographic attributes of consumers, biosecurity in markets, and risk perception among vendors and market administrators. Results will inform future PREDICT bushmeat studies on biological and behavioural risk in RoC.

Other Activities this Period*:*

- Coordinated members of the LNSP, the National Vet Lab in Brazzaville (LNVB), and PREDICT teams in DRC and Cameroon to ensure integration of plans and activities.
- Continued coordination of weekly conference calls involving PREDICT's RoC, Cameroon, and DRC teams to discuss progress and activities.
- Continued to conduct monthly in-country coordination meetings designed to evaluate planning and implementation of project activities.
- Hosted team members from PREDICT Cameroon in Brazzaville in December 2014 for work planning.

RWANDA

Highlights and Success Stories:

- Engaged the Ministry of Health's operational branch, the Rwanda Biomedical Center (RBC) National Reference Laboratory (NRL), as a key partner for human specimen testing through the signing of a memorandum of understanding for collaboration during PREDICT-2.
- Trained six project and government personnel (one project technician, one Rwanda Agriculture Board (RAB) technician and four RBC human technicians) on viral family testing protocols; training was provided on-site by a US-based technician over five weeks in July-August at the NRL and the RAB Wildlife Virology laboratory in Rubilizi.
- Invited to participate in the drafting of a One Health work plan under the Government of Rwanda's One Health Strategic Plan 2014-2018; identified activities for which PREDICT will aim to provide technical support.
- Alerted by the Rwanda Development Board (RDB) to the first ever report of respiratory disease affecting wild human-habituated chimpanzees in Nyungwe National Park, a priority surveillance area; the team was invited by RDB to opportunistically collect fecal samples and forage material from sick chimpanzees in support of Rwanda's expanding response capacity for outbreaks among wildlife populations, especially those that could be hosts or susceptibles of Ebolavirus.

Summary of Surveillance and Field Activities for the Period Oct. 2014-Sept. 2015:

- Developed a wildlife surveillance plan (to be initiated in Year 2) in consultation with the Rwanda Development Board (RDB) with a focus on disease emergence pathways around Volcanoes National Park and in Eastern Province targeting land use commercialization (wildlife tourism); the wildlife surveillance plan will integrate with active governmental influenza, Acute Febrile Illness (AFI), and Severe Acute Respiratory Illness (SARI) surveillance sites identified in collaboration with the Ministry of Health.
- Initiated conversations with the Ministry of Health's operational arm, the Rwanda Biomedical Center (RBC), for potential coordination on human surveillance in Year 2.
- Translated draft human behavioral and biological surveillance questionnaires into Kinyarwanda in anticipation of submission of protocols to the Rwanda Ethics Board for Institutional Review Board approval in Year 2.
- Conducted reconnaissance visits to potential surveillance sites at human-wildlife interfaces and along disease emergence pathways in the greater Nyungwe National Park and Akagera National Park ecosystems, including an on-going primate-human conflict situation near Akagera for which PREDICT assessment was specifically requested by the Rwanda Development Board.

- Opportunistically acquired specimens from 28 primates in close contact with people, including from human-habituated mountain gorillas in Volcanoes National Park and from chimpanzees affected by two respiratory disease outbreaks in Nyungwe National Park.
- Acquired essential field surveillance supplies in preparation for surveillance starting in Year 2.

Summary of Laboratory Development/Testing for the Period Oct. 2014-Sept. 2015:

- Processed 87 (previously extracted) opportunistically collected wildlife samples for transfer to the NRL for viral family testing in Year 2.
- Transferred viral family testing protocols and trained project personnel, as well as RAB and RBC government personnel, on viral family testing protocols in July-August.
- Serviced the generator and laboratory equipment at the RAB Rubilizi Wildlife Virology Laboratory to maintain cold chain for the wildlife samples and biobank.
- Performed a needs assessment of laboratory facilities at the National Reference Laboratory (NRL) and initiated procurement of necessary supplies in preparation for surveillance starting in Year 2.
- Began drafting an *Assessment on Laboratory Collaborations within the One Health Framework,* as requested by the Minister of Health.
- Initiated communications among the National Reference Laboratory; RAB Animal Virology Laboratory; the RAB Wildlife Virology Laboratory; and the University Of California, Davis One Health Institute Diagnostic Laboratory (also a US-based PREDICT reference lab) for external quality assessment and assurance schemes for wildlife zoonoses.

Summary of Stakeholder Engagement and Partner Coordination for the Period Oct. 2014-Sept. 2015:

- Introduced PREDICT-2 to the USAID Mission Rwanda, the Rwanda One Health Steering Committee, and to other government partners, including the Rwanda Development Board, Rwanda Agriculture Board, Rwanda Biomedical Center (Ministry of Health), the Government Ministerial social Cluster, and the University of Rwanda Schools of Veterinary Medicine and Public Health in March in Kigali.
- Invited to participate in Rwanda One Health Steering Committee planning meetings held in February and June in Kigali.
- Met with EPT Partners (Preparedness & Response and One Health Workforce) in Kigali to plan and coordinate Year 1 activities in March and April.
- Invited to participate in the Government of Rwanda's weekly briefings on Ebola alertness and preparedness, March to June.

- Provided informational assistance to the Rwanda Agriculture Board's Epidemiology Team during their Rift Valley Fever investigation, including exploring possibilities for wildlife surveillance.

Other Activities this Period:

- Hired a project veterinarian to assist the Country Coordinator with wildlife fieldwork and laboratory activities.
- Familiarized project personnel with the new EIDITH platform and associated data collection tools for wildlife surveillance .
- Participated in the One Health Demonstration site activities organized by the EPT One Health Workforce in Akagera National Park in August, teaching students about PREDICT and identifying potential interns for future participation in surveillance activities.
- Responded to request by the Rwanda Agriculture Board to help visually assess wild ungulate-livestock contact outside Akagera National Park during a suspected Foot and Mouth Disease outbreak affecting cattle. Complied with request in support of GoR outbreak response readiness.

Training Summary

Topic	Total # Trained*	# Women Trained	# PREDICT Staff Trained	# Government Ministry or Lab Staff Trained	# Students Trained
Lab safety	6	1	1	5	0
Viral detection and discovery	6	1	1	5	0
Grand total	**6**	**1**	**1**	**5**	**0**

**Multiple individuals cross-trained in various topics.*

SENEGAL

Highlights and Success Stories:

- Conducted initial scoping visit and identified primary subaward target for PREDICT-Senegal rollout.

Summary of Surveillance and Field Activities for the Period Oct. 2014-Sept. 2015:

- Under advisement from representatives of the Ministère de l'Environnement et du Dévelopment Durable (Ministry of the Environment and Sustainable Development; MEDD), Institut Sénégalais de Recherches Agricoles, Laboratoire National de l'Elevage et de Recherches Vétérinaires (ISRA, LNERV; Senegalese Institute of Agricultural Research, National Livestock and Veterinary Research Laboratory; Ministry of Agriculture), and FAO Senegal, identified key regions for PREDICT surveillance activities.

Summary of Laboratory Development/Testing for the Period Oct. 2014-Sept. 2015:

- Conducted initial scoping of laboratory activities at Institut Pasteur de Dakar (IPD), African Center of Excellence for Genomics of Infectious Disease (ACEGID), and ISRA.
- Targeted a collaborative for human sample testing between Institut Pasteur de Dakar and neighboring GoS African Center of Excellence for Genomics of Infectious Disease (ACEGID); selected ISRA, LNERV for animal sample analysis and country headquarters for PREDICT operations.

Summary of Stakeholder Engagement and Partner Coordination for the Period Oct. 2014-Sept. 2015:

- Participated in the GHSA planning meeting in Dakar, Senegal, June 2015; the meeting included representatives from the US Embassy in Senegal's Health Policy Working Group, the US State Department, US CDC, USAID/DC, USAID/Senegal, DoD DTRA, USDA, WHO, FAO, IPD, the Ministère de la Sante et de l'Action Sociale (Ministry of Health and Social Action - MSAS), Ministry of Livestock, Department of National Parks (MEDD), Medecins Sans Frontieres, Inter-Regional Veterinary School of Dakar, PATH, and other local organizations; PREDICT supported USG partners in developing GHSA strategies working towards high-level Action Plans for in-country enagement.
- Traveled to Senegal in July, 2015 and engaged key figures at MEDD, FAO, the MSAS, USAID Senegal, the African Center of Excellence for Genomics of Infectious Diseases (ACEGID; coordinated by MSAS and the University Cheikh Anta Diop), and the International Center of Excellence in Malaria Research (ICEMR).
- Initiated subaward proceedings to retain ISRA for primary coordination of PREDICT-Senegal activities.

SIERRA LEONE

Highlights and Success Stories:

- Official engagement delayed due to ongoing EVD outbreak response. No activities were conducted in Year 1.

Summary of Surveillance and Field Activities for the Period Oct. 2014-Sept. 2015:

- No surveillance or field activities were conducted in Year 1.

Summary of Laboratory Development/Testing for the Period Oct. 2014-Sept. 2015:

- No laboratory activities were conducted in Year 1.

Summary of Stakeholder Engagement and Partner Coordination for the Period Oct. 2014-Sept. 2015:

- No stakeholder engagement or partner coordination activities were conducted in Year 1.

Other Activities this Period*:*

- No activities were conducted in Year 1.

SOUTH SUDAN

Highlights and Success Stories:

- PREDICT engaged Bucknell University in a contract for services to test archived specimens collected in-country as a Coronavirus pilot and to begin preliminary scoping work. Bucknell was selected because of their existing relationships with partners that can be leveraged for success.

Summary of Surveillance and Field Activities for the Period Oct. 2014-Sept. 2015:

- Developed a workplan focused on Years 2-5 and selected sites for zoonotic disease surveillance of animals and people in the Doromo area (Nzara County and Western Equitoria State), including bushmeat markets inside game reserves.
- Conducted a preliminary baseline assessment of wildlife sampling investigations to date and identified approximately 1,000 archived bat and rodent tissue samples from previous collections that could be made available for viral detection and discovery.
- Leveraged a partnership with Bucknell University to pair up with existing activities and gain information from an ongoing survey plan with locally hired personnel on wildlife use and knowledge of behavioral risk; preliminary results suggest widespread bushmeat hunting activities that will inform surveillance priorities.

Summary of Laboratory Development/Testing for the Period Oct. 2014-Sept. 2015:

- No laboratory activities were conducted in Year 1.

Summary of Stakeholder Engagement and Partner Coordination for the Period Oct. 2014-Sept. 2015:

- PREDICT global partners have not yet conducted a scoping visit to South Sudan, though partners at Bucknell University have established relationships with the Ministry for Wildlife Conservation and Tourism at the Federal level, as well as at the state and local levels in Central Equatoria State and Western Equatoria State where they have good relationships with the former governor, the minister for local government, and county commissioners for Ezo and Nzara Counties as well as NGO the consortium operating in the region.
- Mission and governmental engagement for implementation of project activities beyond this intial pilot are planned for early in Year 2.

SUDAN

Highlights and Success Stories:

- No activities were conducted in Year 1.

Summary of Surveillance and Field Activities for the Period Oct. 2014-Sept. 2015:

- No surveillance or field activities were conducted in Year 1.

Summary of Laboratory Development/Testing for the Period Oct. 2014-Sept. 2015:

- No laboratory activities were conducted in Year 1.

Summary of Stakeholder Engagement and Partner Coordination for the Period Oct. 2014-Sept. 2015:

- Contacted potential partner (University of Khartoum) to prepare for an initial scoping visit tentatively scheduled for April 2016.

Other Activities this Period*:*

- No activities were conducted in Year 1.

TANZANIA

Highlights and Success Stories:

- Conducted trainings and optimized laboratory operations at the Sokoine University of Agriculture (SUA) lab and a partner lab at the Ifakara Health Institute (planned as a possible site for testing of human specimens in Year 2) to standardize and optimize lab protocols across all sites; trainings included sessions in laboratory safety and updated RNA extraction and viral family level PCR protocols for Arenavirus, Bunyavirus, Coronavirus, Filovirus, Influenzas and Paramyxoviruses, along with best practices for laboratory work flow and data management.
- Contributed to USAID-Tanzania's plan and implementation of the Global Health Security Agenda's (GHSA) action packages in-country during a meeting in Dar es Salaam to coordinate complimentary activities among EPT partners. Attendees included representatives from USAID, DoD DTRA, CDC Tanzania, USAID, OHCEA, Ministry of Health and Social Welfare, Ministry of Livestock and Fisheries Development, National Health Lab, Tanzania Veterinary Laboratory Agency, Tanzania Wildlife Research Institute, and WHO.
- Identified and characterized potential high-risk locations and interfaces in the Coastal (Dar es Salaam and surrounding areas) and Lake Zone (Kagera and Kigoma Districts) to explore biological and behavioral risk factors for disease emergence and to evaluate sites, partnerships, and health facilities for engagement in surveillance activities. The team also held strategic meetings with key local stakeholders, including District Veterinary Officers (DVO's), District Medical Officers (DMO's), District Game Officers (DGO's), the MoH's Director of Epidemiology, and the Director of Veterinary Services, to discuss how to optimize PREDICT's surveillance plans to best target areas of need and to explore opportunities for coordination of human and animal sampling.
- Held planning meetings with Pathogen Detection Lead and lab technicians at the SUA lab in preparation for Year 2 viral detection activities and met with the Director and affiliated scientists of the Government of Tanzania's National Health Laboratory to explore opportunities for collaboration.

Summary of Surveillance and Field Activities for the Period Oct. 2014-Sept. 2015:

- Developed a surveillance plan targeting human and wildlife at the high-risk pathways of intensification of animal production systems and land conversion for commercialization for disease emergence and planned implementation strategies in conjunction with the global team and in-country partners.

Summary of Laboratory Development/Testing for the Period Oct. 2014-Sept. 2015:

- Extracted and transported 50 tissue samples collected from the participatory bushmeat value chain project established in villages in the Ruaha Ecosystem during PREDICT-1 for viral screening; results expected in Year 2.

Summary of Stakeholder Engagement and Partner Coordination for the Period Oct. 2014-Sept. 2015:

- Shared bat and rodent test results from PREDICT-1 with the Ministries of Livestock and Fisheries Development, Ministry of Health and Social Welfare, Tanzania Wildlife Research Institute, and National Institute for Medical Research (NIMR).
- Participated in meetings with Ministry of Livestock and Fisheries Development officials led by the Director of Veterinary Services and discussed various livestock intensification practices and common zoonotic disease challenges in Tanzania.
- Participated in meetings with officials from the Ministry of Health and Social Welfare, Preventive Services Department to explore information on geographic areas with reported cases of fevers of unknown origin and influenza like illness in anticipation of initiating human surveillance activities.
- Visited sites in areas targeted for surveillance in PREDICT-1 in the Udzungwa and Ruaha ecosystems to meet with and distribute risk communication materials (project updates, reports, and summarized findings) to park wardens, ecologists, veterinary officers, and medical officers from surrounding health facilities.

Other Activities this Period:

- Trained 14 international veterinary students and one human medical student from Germany in the One Health and PREDICT's Approach to disease surveillance, specifically human-wildlife contact in Kilombero Valley region.
- Shared PREDICT-1 final report with the USAID-Tanzania Mission and all in-country stakeholders.
- Participated (Country Coordinator) in an intensive FAO regional field epidemiology training program for veterinarians held in Arusha in July; and presented (Principal Investigator) on PREDICT's surveillance and risk assessment approach.
- Received acceptance of two abstracts for presentation at the Tanzania Wildlife Research Institute's 9th Scientific Conference in December; presentations are entitled, "Systematic surveillance and capacity strengthening to detect emerging viral zoonoses of wildlife origin in Tanzania" and "Detection of arenaviruses in rodent and shrews from selected wildlife-human interfaces in Tanzania".
- Hosted a journalist from Public Radio International exploring pandemic risk pathways that drive viral emergence between humans and animals during visits to PREDICT-1 surveillance areas in the Kilombero valley; the resulting story is available at http://www.pri.org/stories/2015-04-16/prevent-next-ebola-scientists-try-catch-new-viruses-they-break-out.

Training Summary

Topic	Total # Trained*	# Women Trained	# PREDICT Staff Trained	# Government Ministry or Lab Staff Trained	# Students Trained
One Health Approach	15	15	0	0	15
Field epidemiology	1	0	1	0	0
Lab safety	7	2	3	0	0
Viral detection and discovery	5	2	1	0	0
Grand total	**22**	**17**	**3**	**0**	**15**

**Multiple individuals cross-trained in various topics*.

UGANDA

Highlights and Success Stories:

- Briefed the Government of Uganda's State House in Entebbe in March during a government-led primate capture and sampling exercise on State House grounds and presented on the public health risks posed by human-primate contact and the purpose and objectives of the PREDICT-2 project to the President's office.
- Participated in a workshop with the Ministry of Health and partners in April in Entebbe to review and develop Standard Operating Procedures (SOPs) and guidelines for Ebola and Marburg virus disease management from detection and initiation of effective response to effective implementation of outbreak control measures, taking lessons from the West Africa Ebola outbreak; additional activities included the review of the structure and composition of the National Task Force.
- Signed a renewed cooperative agreement with Makerere University Walter Reed Project (MUWRP) for implementation of viral family testing of animal and human samples at MUWRP's Influenza Research laboratory at Makerere University, Kampala (animal specimens) and at the MUWRP laboratory based at the Uganda Viral Research Institute, Entebbe (human specimens).
- Invited to participate in a Global Health Security Agenda (GHSA) meeting in Kampala in June to help develop the five year Uganda-specific milestones for achieving GHSA objectives according to action packages within the GHSA Prevent-Detect-Respond framework. Identified key partners in implementation of the activities necessary to achieve each milestone.
- Received Institutional Review Board approval from the Uganda Research Ethics Committee (at Mbarara University) and the Uganda National Council for Science and Technology for qualitative research for behavioral risk surveillance and characterization at the animal-human interface.

Summary of Surveillance and Field Activities for the Period Oct. 2014-Sept. 2015:

- Hired a new field veterinarian to assist the Country Coordinator with field surveillance activities.
- Worked with the Uganda Wildlife Authority and the Uganda Wildlife Education Center to collect samples from vervet monkeys that were being trapped and translocated from sites in Entebbe (including the State House) where the level of primate contact with humans had reached nuisance levels; collected approximately 340 samples from 68 vervet monkeys.
- Continued to collaborate with Buhoma Community Hospital and Mutolere Catholic Hospital in southwestern Uganda to discuss and plan partnering on human surveillance starting in Year 2.
- Developed a Year 2 work plan for wildlife and human surveillance in consultation with government partners; visited potential surveillance sites to assess opportunities and feasibility for concurrent wildlife and human sampling.
- Pilot-tested data collection forms and behavioral surveillance data forms at several potential surveillance sites.

- Acquired essential supplies for field surveillance starting in Year 2.

Summary of Laboratory Development/Testing for the Period Oct. 2014-Sept. 2015:

- Provided Makerere University Walter Reed Project (MUWRP) with updated viral family testing protocols.
- Assisted MUWRP with acquisition of essential laboratory supplies in anticipation of laboratory testing commencing in Year 2.
- Serviced subzero freezers to maintain reliable cold-chain for storage of animal samples.
- Inventoried all bio-banked specimens.

Summary of Stakeholder Engagement and Partner Coordination for the Period Oct. 2014-Sept. 2015:

- Participated in the Queen Elizabeth National Park (QENP) ecosystem research and development partners' meeting in Kasese in January to identify research and development priorities and to set up strategic collaborations for wildlife and human health in the QENP ecosystem.
- Participated in a Bwindi Mgahinga Conservation Area partners meeting February to discuss potential collaborations on animal health issues including PREDICT.
- Met with the National Animal Disease Diagnostic and Epidemiology Center (NADDEC) of the Ministry of Agriculture, Animal Industry and Fisheries (MAAIF) in March in Entebbe to discuss potential collaboration on livestock sampling.
- Met with Chief of Party for Preparedness and Response and his staff in March in Kampala to discuss One Health networks and platforms and to provide an overview of PREDICT-2 surveillance plans.
- Attended a FAO Eastern Africa Regional Animal Health Network meeting in Kampala in September to align EPT partner activities in Uganda.
- Participated in a One Health workshop in Entebbe in September to review the country surveillance and sector preparedness mechanisms within the East African Integrated Disease Surveillance Network.

Other Activities this Period:

- Completed training of project personnel on qualitative survey methods in August in preparation for qualitative survey work in Year 2.
- Provided on-ground technical assistance to Queen Elizabeth National Park in November with investigation of a disease event involving 17 goat mortalities, in support of cross-sectoral outbreak awareness and preparedness training.
- Reviewed all PREDICT protocols and participated in on-line training on the new internal data management system (EIDITH).

Training Summary

Topic	Total # Trained*	# Women Trained	# PREDICT Staff Trained	# Government Ministry or Lab Staff Trained	# Students Trained
Behavior risk	5	3	2	0	2
Safe sample transport	3	1	0	0	3
Biosafety and PPE	3	1	0	0	3
Safe animal handling and sampling	3	1	0	0	3
Grand total	**8**	**4**	**2**	**0**	**5**

**Multiple individuals cross-trained in various topics.*

BANGLADESH

Highlights and Success Stories:

- Formalized partnerships with Government of Bangladesh (GoB) and other in-country organizations through the signing of a Memorandum of Understanding (MOU) to support disease surveillance, wildlife health, ecological and conservation research, and One Health development: MOUs executed with the Ministry of Health and Family Welfare, Forest Department, and Chittagong Veterinary and Animal Sciences University (CVASU).
- Published an article in *Nature Communications* entitled, **"**Non-random patterns in viral diversity" (Section 5: Anthony et al., 2015).

Summary of Surveillance and Field Activities for the Period Oct. 2014-Sept. 2015:

- Conducted preliminary site assessments in Dhaka (Old Dhaka and Dhamrai), Narayanganj (Bondor), Gazipur Safari Park, Chandpur, Chakaria Safari Park, Kaptai, Barishal (Uzipur), Shariatpur, Madaripur, Gazipur, Narsingdi, and Sylhet Districts for macaque sampling along the land conversion pathway (including urban, rural, and areas with low anthropogenic disturbance).
- Collected samples from a total of 1,264 macaques along the land conversion pathway from the following districts: Barisal, Chandpur, Cox's Bazar, Dhaka, Gazipur, Madaripur, Narayanganj, Narsingdi, Rangamati, Shariatpur, and Sylhet. Samples were also collected from four bats along the land conversion pathway. The bat samples will be tested in-country at the icddr,b laboratory; macaque samples will be tested at Columbia University's Center for Infection and Immunity (CII).
- As part of the first MERS surveillance activity in Bangladesh, collected samples from 60 dromedary camels from a live animal market in Dhaka. The camels were imported for an annual festival and sampled to screen for MERS coronavirus. These samples will be tested for coronavirus RNA and antibodies against MERS CoV at icddr,b; lab reagents were provided by NIH NIAID Rocky Mountain Labs.
- Developed a surveillance plan to prioritize and coordinate human-animal sampling sites and target populations for biological and behavior risk data collection; targeted sites include high-risk urban, rural, and low disturbance settings with human-macaque interaction along a land conversion gradient.
- Obtained IRB approval for conduct of qualitative and observational research to address people's beliefs and activities concerning their daily interactions with animals to inform on transmission risks and to help identify intervention opportunities. Following IRB approval, the team conducted 40 ethnographic interviews and two focus group discussions at surveillance sites; data from the interviews are being transcribed and translated for analysis.
- Tested and reviewed EIDITH data collection forms (site/event, animal samples and specimens).
- Evaluated EIDITH data collection field tools for the Human Questionnaire (Section 6.1).

- Worked with the global team to design and introduce the in-depth, standardized, qualitative human behavioral risk data collection protocol.

Summary of Laboratory Development/Testing for the Period Oct. 2014-Sept. 2015:

- Tested 452 throat swabs collected from rodents and shrews during PREDICT-1 at icddr,b for six viral families with positive results detected for Adenoviruses, Astroviruses, Influenza viruses, and Rotavirus-A. These results have been reported to the GoB.
- Tested 458 fecal samples collected from rhesus macaques during PREDICT-1 at the Center for Infection and Immunity, Columbia University (CII) using consensus polymerase chain reaction and high-throughput sequencing and detected 184 viruses from 14 viral families. These results were approved by GoB, released on HealthMap, and published in the article referred to above **"**Non-random patterns in viral diversity" (Section 5).
- Strengthened in-country field and lab cold chain by acquiring additional liquid nitrogen dry shippers and installing a new -80^{o}C ultra low freezer at the Institute of Epidemiology, Disease Control, and Research (IEDCR).

Summary of Stakeholder Engagement and Partner Coordination for the Period Oct. 2014-Sept. 2015:

- Held coordination meetings with the Department of Livestock Services, Forest Department, and Ministry of Health and Family Welfare (IEDCR).
- Together with FAO partners, met with the Department of Livestock Services and developed a plan for concurrent sampling in Year 2 and discussed capacity within GoB veterinary laboratories.
- Maintained regular meetings with the USAID Mission to discuss plans.
- Participated in a workshop organized by WHO and IEDCR for the Development of Tools for Influenza Pandemic Risk Assessment (TIPRA) and its potential use in Bangladesh.
- Organized the One Health Bangladesh Conference with the Epidemiology Unit in the Department of Livestock Services, Epidemiological Association of Bangladesh, Health Population and Nutrition Sector Development Program, Forest Department, Bangladesh Livestock Research Institute, CVASU, Bangladesh Poribesh Andolon, UNICEF, icddr,b, CDC, Massey University, IEDCR, WHO, and FAO and presented PREDICT-1 achievements and future directions.
- Participated in the EPT-2 partner coordination meeting organized by USAID and FAO and presented Year 1 plans and activities.
- Met with the P&R team to discuss project plans and opportunities for collaboration.
- Participated in the Global Health Security Agenda (GHSA) partners' meeting organized by USAID regarding ongoing and upcoming activities and opportunities to link, coordinate, and integrate GHSA and EPT-2.
- Participated in GoB-FAO Technical Planning Workshop for developing activities necessary to implement the USAID-funded EPT-2/GHSA program in Bangladesh.

- Participated in the National One Heath Meeting and presented project activities.
- Participated in the One Health Policy Dialogue Consultative Meeting on the establishment of the One Health Secretariat.

Other Activities this Period:

- Conducted training workshop on qualitative behavioral assessment for 19 participants in collaboration with IEDCR.
- Conducted training for six Forest Department staff and one new PREDICT team-member on zoonotic disease surveillance, biosafety, and field anesthesia of macaques (see Training Summary below).
- Translated ethnographic interview guides, focus group guides, and observational protocols, along with all workshop training materials required for development of behavior risk capacity in-country and completed training of 32 individuals, including four PREDICT team members and five GoB personnel in anticipation of the roll-out of behavior risk activities described above.
- Contributed to a workshop on how to introduce One Health to young professionals designed to explain the One Health concept and its importance to future One Health leaders.
- Participated in a stakeholder workshop sponsored by the Royal Veterinary College, University of London on behavioral adaptations in live-poultry trading and farming systems and zoonoses control in Bangladesh, as part of a project designed to develop policies to reduce the risk of human behavior contributing to the spread of emerging zoonoses in these systems.

Training Summary

Topic	Total # Trained*	# Women Trained	# PREDICT Staff Trained	# Government Ministry or Lab Staff Trained	# Students Trained
Behavior Risk	32	8	4	5	11
Biosafety and PPE	6	0	2	4	0
Safe Animal Capture	3	0	2	1	0
Total	**36**	**8**	**4**	**9**	**11**

**Multiple individuals cross-trained in various topics.*

CAMBODIA

Highlights and Success Stories:

- Engaged government partners from the Cambodia CDC, Ministry of Agriculture, and the Forestry Administration to develop a coordinated One Health field approach to establish a multi-sectoral field team with animal, human health, and forestry government counterparts and successfully went into the field as a One Health team to complete pilot sampling of rodents and bats.
- Received an award for a presentation at the Molecular Epidemiology and Evolutionary Genetics of Infectious Diseases (MEEGID) conference in Bangkok; the presentation featured results obtained from Cambodian and Lao bat Coronaviruses detected at IPC using PREDICT protocols.
- Initiated plans with FAO for coordinated livestock sampling to occur concurrent with wildlife and human sampling at two high-risk interface sites: the rodent trading site in Kandal Province (Koh Thom district) at the border with Viet Nam and bat farms in in the Rokar Ar community in Kampong Cham Province.
- Met with National Institute of Public Health (Ministry Of Health) to initiate process for collaboration to receive human samples for testing at SARI and ILI sites using PREDICT protocols.

Summary of Surveillance and Field Activities for the Period Oct. 2014-Sept. 2015:

- Conducted assessments at the Cambodia-Viet Nam border at a rodent trading site in Kandal Province to evaluate the site for concurrent wildlife, livestock, and human sampling and collected samples from 179 rodents (1664 samples collected) for testing for eight priority viral families.
- Evaluated bat farms as a high-risk interface and disease emergence pathway for future concurrent wildlife, livestock, and human surveillance and collected samples from 109 bats and 16 rodents (420 fecal and urine samples) in and around farms in Kampong Cham province for testing for eight priority viral families.

Summary of Laboratory Development/Testing for the Period Oct. 2014-Sept. 2015:

- Formulated plans and rolled-out updated PREDICT protocols for diagnostic testing targeting eight viral families.
- Initiated high throughput sequencing for further characterization of the genomes of Coronaviruses detected in PREDICT-1 with UC Davis and Columbia University.
- Met with FAO to discuss continued training of laboratory staff from the National Veterinary Research Institute (NaVRI - Ministry of Agriculture, Forestry, and Fisheries) and potential testing of livestock samples at the project lab at the Institute Pasteur de Cambodge.

Summary of Stakeholder Engagement and Partner Coordination for the Period Oct. 2014-Sept. 2015:

- Participated in One Health Platform Meeting at the Royal University of Agriculture.
- Met with the Vice Director for International Relations and the Dean of the Faculty of Veterinary Medicine from the Royal University of Agriculture (RUA) to discuss continued training opportunities for students.
- Conducted field sampling together with NaVRI, the Forestry Administration (FA), and the Cambodian Communicable Disease Control Department (CDC).
- Met with relevant NaVRI, FA, and National Institute for Public Health (NIPH) government partners to plan for laboratory training and joint diagnostic testing using PREDICT protocols, including initiation of testing at the government animal health laboratory NaVRI.
- Attended and shared surveillance plans at Zoonotic Technical Working Group meetings (participants included NaVRI, FA, CDC, USAID, USCDC, WHO, FAO, and IPC)

CHINA

Highlights and Success Stories:

- Strengthened laboratory capacity by improving sampling, analysis, data reporting, and quality assurance/control workflow among field sites and both Wuhan Institute of Virology and Guangdong Centers for Disease Control.
- Detected a novel Coronavirus clustering with the SARS-like Coronaviruses in *Rhinolophus* bats from Guangdong (findings are detailed in a manuscript published in *Nature Medicine* this November: Menachery et al., 2015 “A SARS-like cluster of circulating bat coronaviruses shows ponteital for human emergence”). Further characterization of this Beta coronavirus is underway, including sequencing of spike proteins, to determine if it has the potential to infect other hosts.
- Expanded the core capabilities of the China team to include skills and expertise in behavioral risk investigations through trainings in human behavioral data collection in Yunnan, Guangxi, and Guangdong. All materials, guides, and data collection tools for behavioral risk activities (Behavioral Research: “Qualitative Research for Behavioral Risk Surveillance and Characterization”) were translated into Chinese and provided to teams including the ethnographic interview guides, focus group guides, and observational protocols. In total, 17 individuals received training with the teams implementing new skills as activities were initiated in Yunnan, Guangxi, and Guangdong. These trainings are part of the six-country qualitative research project that will inform on PREDICT surveillance and in-country intelligence on human-animal contact and surveillance prioritization.
- Conducted approximately 65 ethnographic interviews and four focus groups in Yunnan, Guangxi, and Guangdong. Preliminary findings suggest that there is a consistent perception that wildlife is dwindling, though bats continue to be opportunistically hunted and eaten. One intervention implication is potential conservation readiness, since communities express distress at the change in wildlife abundance due to overhunting and environmental degradation.

Summary of Surveillance and Field Activities for the Period Oct. 2014-Sept. 2015:

- Collected specimens from 459 bats (20 species) from Guangdong (Yingde Huidong, Zengcheng, Zhuhai, and Conghua counties) and Guangxi (Guilin county) provinces in locations identified as proximate to humans and agricultural animals.
- Collected acute syndromic human samples (passive surveillance for five syndromes of unknown origin: hemorrhagic fever, encephalitis, respiratory fever with rash and fever with diarrhea) from 13 hospitals in Guangdong Province.
- Identified Yunnan hospitals with Infectious Disease Departments with the capability, interest, and patient populations relevant to implement surveillance.

Summary of Laboratory Development/Testing for the Period Oct. 2014-Sept. 2015:

- Tested 456 bat samples (rectal swabs and nasopharyngeal samples) for Paramyxovirus and Coronavirus; obtained sequencing results confirming 13 Paramyxovirus-positive and 95 Coronavirus-positive results. Beta Coronaviruses related to SARS or MERS will be identified and spike proteins sequenced.
- Tested 74 encephalitis syndrome samples and 20 respiratory syndrome samples for 12 viruses: Paramyxovirus, Alphvirus, Hantavirus, Seadornavirus, Flavivirus, Bunyavirus, Henipavirus, Coronavirus, Phlebovirus, Rhabdovirus, Filovirus, and Enterovirus; obtained sequencing results confirming one Paramyxovirus and Henipavirus dual positive result (Henipavirus result later confirmed negative).
- Tested 94 human respiratory samples for four viruses: Paramyxovirus, Influenzavirus, Coronavirus, and Filovirus; obtained the DNA sequencing results confirming three Paramyxovirus-positives, three Influenza-positives, and one Coronavirus-positive.
- Conducted a sequence analysis training at Wuhan Institute of Virology and the Pathogenic Microbiology Institute in Guangdong and provided a Geneious license to two personnel at each of these institutes.

Summary of Stakeholder Engagement and Partner Coordination for the Period Oct. 2014-Sept. 2015:

- Met with collaborators at Wuhan University School of Public Health to plan behavioral risk research in Year 2.
- In collaboration with FAO, confirmed all Yunnan, Guangdong, and Guangxi field sites for concurrent sampling in Year 2.
- Participated in the China CDC's annual "National Vector-borne Disease Surveillance Workshop, Xiamen" and provided an update on disease control and prevention policy revisions in China.
- Participated in the 6th "Emerging Viral Diseases Symposium" in Wuhan and discussed PREDICT-2 China implementation with implementing partners, as well as in-country teams from GDCDC and Wuhan Institute of Virology.
- Met with collaborators from Fudan University in Shanghai and Oklahoma University, USA to plan avian influenza sampling and human surveillance in Jiangxi Province.
- Participated in the The 6th Annual World Congress of Virus and Infections in Shanghai organized by BIT Congress, Inc.
- Participated in the 7th Annual Global Virus Network Meeting in Beijing; also visited China CDC Laboratory in Beijing; presented on PREDICT work in China at both.

Other Activities this Period:

- Revised laboratory data QA/QC workflow and reviewed sequence result interpretations from PREDICT-1.
- Incorporated data from surveys, trainings, field, and labs into EIDITH forms, with plans to upload all data early in Year 2.

- Secured ethical approval from Wuhan University School of Public Health and Guangdong Center for Disease Control for behavioral research.
- Began preparation of a manuscript: “Zoonotic Transmission Risk in Workers with Wildlife Contact.”
- Published in *Journal of General Virology*, “Detection of diverse novel Astroviruses from small mammals in China.”
- Reviewed result release approval process with in-country partners.

Training Summary

Topic	Total # Trained*	# Women Trained	# PREDICT Staff Trained	# Government Ministry or Lab Staff Trained	# Students Trained
Behavior Risk	17	5	2	15	1
Viral detection and discovery	1	1	0	1	0
Total	**19**	**6**	**3**	**16**	**1**

**Multiple individuals cross-trained in various topics.*

INDIA

Highlights and Success Stories:

- Successfully identified a primary implementing partner (the Public Health Foundation India – PHFI) and hired the Country Coordinator.
- Together with FAO and the USAID India Mission GHSA/EPT Point of Contact, attended the GHSA stakeholder meeting in Delhi, organized by the US CDC, to coordinate activities with the GoI National Centre for Disease Control (NCDC) and other potential GoI partners. During the meeting, PREDICT engaged technical leads from the US CDC and NCDC, the National Institute of Virology (NIV), National Institute of Mental Health and Neurosciences (NIMHANS), India Council for Medical Research (ICMR), the Ministry of Agriculture (MoA), and the Ministry of Health and Family Welfare (MOHFW) and identified potential national and state-level collaborators for upcoming in-country activities. As a result, PREDICT and FAO were encouraged by the MoA's Department of Husbandry, Dairying and Fisheries (DHDF) Director to initiate work at the state level and establish proof-of-principle for proposed GHSA/EPT, multi-sectoral surveillance activities. State level visits will be conducted in early Year 2.

Summary of Surveillance and Field Activities for the Period Oct. 2014-Sept. 2015:

- No surveillance or field activities conducted in Year 1.

Summary of Laboratory Development/Testing for the Period Oct. 2014-Sept. 2015:

- No laboratory testing conducted in Year 1.

Summary of Stakeholder Engagement and Partner Coordination for the Period Oct. 2014-Sept. 2015:

- At the request of the Ministry of Agriculture (ICAR) and DHDF, provided 2-page concept notes summarizing EPT/GHSA activities.
- Met with US CDC lead for India to discuss GHSA activity and potential opportunities to coordinate human, wildlife, and livestock surveillance around human acute encephalitis syndrome of unknown origin in northern India (e.g., Uttar Pradesh, West Bengal)

INDONESIA

Highlights and Success Stories:

- The PREDICT Country Coordinator was appointed to the expert panel for the National Committee for Zoonosis Control (KomNas Zoonosis) – a trans-ministry platform that serves as the national task force for addressing zoonotic disease issues.
- PREDICT participated in the workshop on Ebola contingency plans in Bogor. This workshop was conducted by the Indonesian national disaster agency (BPPB) for preparation of contingency plans for Ebola outbreak in Indonesia.
- Over the course of two weeks, successfully trained lab staff (11 individuals, four of them women) from the Ministry of Agriculture Laboratories and Disease Investigation Centers (DICs) Maros and Banjarbaru in laboratory safety and intensive hands-on laboratory investigations from sample extraction to final sequencing of positive specimens. In addition, follow-up trainings were organized in collaboration with FAO on bioinformatic analysis of sequence results from domestic animal screening. During the trainings, mammal and avian domestic animal specimens from DICs at Maros and Banjarbaru were screened for three viral families (Coronaviridae, Paramyxoviridae, Herpesviridae) and two additional viral pathogens (Influenza A, and Encephalomyocarditis virus) using PREDICT protocols. Results were sent by DICs to MoA Director of Animal Health. As a result, MoA and DIC lab staff are well equipped with the knowledge and technical skills to complete viral detection and discovery activities.

Summary of Surveillance and Field Activities for the Period Oct. 2014-Sept. 2015:

- Developed surveillance and specimen collection plans for wildlife, domestic animals, and humans across the animal value chain of Sulawesi, including wet markets of Tomohon and Manado, North Sulawesi; live bat source populations in Gorontalo Province; and frozen bats and domestic animals from South Sulawesi – animal specimen collection is planned for early 2016.
- Continued to implement and improve systems for standardized sampling data collection and tested protocols to characterize pathways for disease emergence within epizones, including optimal collection, processing, storage, and transport.
- In coordination with other EPT partners, identified sites in Manado, Bali, and Banjarmasin for surveillance and concurrent sampling of humans within identified high-risk regions and transboundary epizones and assessed local capacity and logistical issues related to implementation of activities at each site.
- Continued to support logistics for human sampling by providing specimen collection materials (swabs, VTM, and tubes) to local collaborators in Bali, Banjarmasin (South Kalimantan) and Manado (North Sulawesi) for ongoing

surveillance at health facilities targeting patients with fever of unknown origin and undiagnosed severe respiratory infections.
- Contributed to the development of protocols for human sampling and behavioral surveys with global team and conducted preliminary training with staff in behavioral risk survey methods; follow-up training with global staff planned for Year 2.

Summary of Laboratory Development/Testing for the Period Oct. 2014-Sept. 2015:
- Continued to receive and test archived, undiagnosed human specimens from partners in hospitals and universities: Ulin Hospital, Banjarmasin; Warmadewa University, Bali Cipto Mangunkusumo Hospital, Jakarta; Kandou Hospital, Manado; Pajajaran University, Bandung.
- Optimized PCR protocols for expanded viral characterization of archived animal specimens found positive from PREDICT-1 with focus on specific protocol optimization for spike gene of Coronaviruses and fusion gene of Paramyxoviruses.
- Purchased a new -80^{o}C freezer for wildlife specimen storage at PRC-IPB Bogor.
- One PREDICT team member participated in TEIN4 Next Generation Sequencing (NGS) Training at Perdana University, Kuala Lumpur, Malaysia.

Summary of Stakeholder Engagement and Partner Coordination for the Period Oct. 2014-Sept. 2015:
- Participated in EPT-2 kick-off and planning meetings to coordinate activities across EPT partners.
- Attended monthly meetings with USAID Jakarta, EPT-2 partners, WHO, FAO, CDC, and other partners.
- Provided technical support during Quarter 1 meetings with Institute of Vector and Reservoir Control Research and Development, Salatiga, for vector and reservoir investigations.
- Participated in focus group discussions with stakeholders and the National Commission for Wildlife Health to finalize the “Guide for Prevention and Control of Infectious Disease in Wildlife”; the resulting document will support training of forest rangers and wildlife staff in future.
- Participated in several coordination meetings with FAO and USAID to synchronize concurrent sampling of wildlife and domestic animals.
- Completed scoping visits to Maros (S. Sulawesi) and Banjarbaru (S. Kalimantan) with FAO ECTAD-Indonesia partners and transferred technology for PREDICT Laboratory Protocols to the Indonesia national veterinary labs functioning under the Ministry of Agriculture, Directorate of Animal Health.

Other Activities this Period:

- Interviewed candidates to expand core project staff with the addition of a new human behavioral research coordinator and an assistant to the country coordinator; both to be hired in Year 2.
- Submitted proposal for qualitative human behavioral research in N. Sulawesi; currently under final review at Ministry of Research, Technology, and Higher Education in conjunction with accompanying Foreign Research Application.
- Attended E-ASIA joint research program scientific workshop on Infectious Diseases and Associated Malignancies inYangon, Myanmar.
- Attended the International Conference on Emerging Infectious Diseases in Atlanta, Georgia and presented a poster presentation with title: "*Coxsackievirus B3: an Etiologic Agent of Acute Febrile Illness in Bandung, Indonesia.*"
- Presented PREDICT at the Third International One Health Congress, Amsterdam, Netherlands.

Training Summary

Topic	Total # Trained*	# Women Trained	# PREDICT Staff Trained	# Government Ministry or Lab Staff Trained	# Students Trained
Behavior risk	1	0	1	0	0
Safe sample transport	1	0	0	0	0
Biosafety and PPE	8	3	1	7	0
Safe animal handling and sampling	1	0	1	0	0
Viral detection and discovery	13	4	1	11	1
Total	**13**	**4**	**1**	**11**	**1**

**Multiple individuals cross-trained in various topics.*

LAO PDR

Highlights and Success Stories:

- Organized the “Lao PDR Synchronized Surveillance Planning Meeting” in Vientiane in August with key government partners (the National Animal Health Laboratory, NAHL, and the National Center for Laboratories and Epidemiology, NCLE), the local office of FAO, as well as USAID RDMA staff. The meeting resulted in an integrated work plan for concurrent surveillance with FAO, with potential surveillance sites selected. NCLE will be responsible for all human sample analysis for PREDICT-2, NAHL will undertake all wild-animal sample analysis, and FAO will conduct domestic animal surveillance.
- In collaboration with PREVENT, submitted a manuscript for publication on the disease risks associated with the wildlife trade in Lao PDR; the manuscript is currently in review.
- Identified and hired a country coordinator in Vientiane.
- Established an office at the NAHL; establishing this direct connection with the government collaborator responsible for animal testing for PREDICT-2 activities in Lao PDR will provide opportunities for ongoing collaboration, facilitate protocol implementation, and solidify relationships among collaborators.

Summary of Surveillance and Field Activities for the Period Oct. 2014-Sept. 2015:

- Together with in-country collaborating partners, including NAHL, NCLE, and FAO, identified Champasak Province as a candidate for scoping visits to identify sampling sites for Year 2. From the initial information available from consulting with Lao PDR government staff and FAO, Champasak Province provides excellent opportunities to work at the human-animal interface along the animal value chain pathway due the volumes of wildlife being hunted and traded in the area. Previous PREDICT work in the area suggests that villagers and wildlife traders will be willing to participate in biological and behavioral studies.
- With input from all partners, planned scoping activities for November 2015, with senior representatives from each organization agreeing to be part of the field team.

Summary of Laboratory Development/Testing for the Period Oct. 2014-Sept. 2015:

- Assessed the facilities at NAHL and NCLE, the in-country human and animal laboratories, respectively, and identified equipment and supply needs.
- Held meetings between the Country Coordinator and key senior members of both laboratories to discuss the needs of each as they related to PREDICT-2 activities.

Summary of Stakeholder Engagement and Partner Coordination for the Period Oct. 2014-Sept. 2015:

- Participated in the Lao Inception Meeting with the RDMA to discuss the PREDICT-2 scope of work and to coordinate with EPT-2 partners in-country and

within the region; meeting attendees included Lao PDR government officials and representatives from PREDICT Global and China, as well as FAO Bangkok and Lao PDR, to encourage a regional and epizonal approach to surveillance and work plan development.

- Prepared a memorandum of understanding to allow work with the Ministry of Health and the Department of Livestock and Forestry.

MALAYSIA

Peninsular Malaysia:

Highlights and Success Stories:

- Assisted the Department of Wildlife and National Parks (PERHILITAN – Ministry of Natural Resources and the Environment) with construction of their new National Wildlife Forensic Laboratory, which includes ISO 17025 standards for forensic work and BSL2 disease diagnostic capabilities; the lab will be online by end of December.
- Worked with the Minstry of Health (MoH) to set up a comparative evalution of the PREDICT protocols with traditional testing at the National Public Health Laboratory (NPHL) and for incorporation into their Standard Operating Procedures (SOP) for patients with unidentified diseases.
- Successfully engaged with US Embassy partners by attendeding dinner at US Ambassador's Residence to discuss PREDICT and meeting with the Embassy's Counselor for Economic Affairs and Environment, Science, Technology and Health Officer to discuss progress. As a result, PREDICT was asked to provide a briefer for US Secretary of State Kerry's visit to Malaysia in October 2015.

Summary of Surveillance and Field Activities for the Period Oct. 2014-Sept. 2015:

- Completed Kuala Lipis Orang Asli and Gua Musang site visits in preparation for human sampling, to evaluate site and request permission to sample wildlife and livestock.
- With PERHILITAN, collected 1,567 samples from 354 animals (108 bats, 324 samples; 46 non-human primates, 368 samples; 145 rodents and shrews, 435 samples; and 55 other taxa, 440 samples); all samples will be entered into EDITH and tested in Year 2.

Summary of Laboratory Development/Testing for the Period Oct. 2014-Sept. 2015:

- Worked with MoH and NPHL to integrate PREDICT testing protocols into NHPL workflow and to strengthen lab capacity for viral detection; samples will be processed by PREDICT and two NHPL staff members to maximize capacity building efforts.
- At the request of the MoH, screened 54 archived Orang Asli samples from patients with undiagnosed acute febrile illness that were originally submitted for culture to NPHL. The samples were screened using PREDICT protocols, and positives were submitted for sequencing to compare to culture results. Data analysis in now in progress. This exercise and identified discrepancies will help us to address any needed optimization in our PCR protocols and in potentially identifying issues in partner labs to help target capacity building efforts.

- Sent PERHILITAN Research Officer in charge of developing diagnostic lab to the Queensland Department of Agriculture, Forestry and Fisheries Biosecurity Sciences Laboratory in Brisbane to observe BSL2 laboratory operations.

Summary of Stakeholder Engagement and Partner Coordination for the Period Oct. 2014-Sept. 2015:

- Met with all in-country partners to discuss project aims.
- Held meetings with One Health Workforce to discuss activities and areas for collaboration.
- Received a request to advise PERHILITAN on investigating rabies outbreak in Peninsular Malaysia.
- Updated human surveillance protocols with MoH to conform to PREDICT aims; PERHILITAN to conduct concurrent wildlife sampling in Orang Asli villages; MoH to provide Orang Asli samples from hospital patients with unidentified disease.
- Met with new acting Director General, Dept. of Veterinary Services (DVS) and new Director of the Veterinary Research Institute (VRI) to discuss PREDICT project and concurrent livestock surveillance in the Orang Asli villages.

Other Activities this Period*:*

- At the request of NPHL began to plan training for designing PCR primers and oligos, molecular cloning, bioinformatics, and sequence analysis; this activity is planned for Year 2.
- Conducted multiple trainings with PERHILITAN: 23 wildlife officers were trained on PPE and Powered Air Purifying Respirator use along with N95 and P100 mask fit tests; 20 wildlife officers were trained in biosafety containment levels, risk assessments for field and lab work, sample handling and required PPE, disinfection, contamination, and laboratory waste management.
- Published a paper in *EID,* “Macacine Herpesvirus 1 (B virus) in Wild-caught Long-Tailed Macaques (*Macaca fascicularis*) Following Capture and Transport in Malaysia” (Section 5: Lee et al., 2015).
- Presented poster “Assessing viral diversity within non-human primates of Peninsular and Bornean Malaysia” at Wildlife Disease Association International Conference, July 2015, Queensland, Australia.

Sabah:

Highlights and Success Stories:

- Successfully recertified the Wildlife Health Genetic and Forensic Laboratory (WHGFL) as a BSL2 laboratory according to NIH and CDC guidelines.
- Assisted the Sabah Wildlife Department (SWD) with lab diagnosis of Hepatitis B in three quarantined Orangutans; the identified Orang strain is not a public health concern.
- Contributed to the development of Malaysia’s One Health workforce by training 35 wildlife staff from Sabah Wildlife Department, Lok Kawi Wildlife Park, and Sepilok Orangutan Rehabilitation Centre in zoonoses, biosafety and PPE (with

respirator fit testing), safe animal capture and handling, risk assessment, and lab safety. In addition, conducted multiple trainings with Wildlife Health Unit and DGFC staff, including field and lab first aid trainings for three PREDICT, three WHU, and six DGFC staff, and biosafety and PPE, safe animal handling and sampling of bats and non-human primates, cold chain maintenance, and safe transport of samples for 15 individuals from WHU DGFC, Borneo Sun Bear Conservation Centre, University Putra Malaysia, and British Columbia Institute (See Training Summary below for details). As a result, WHU, DGFC, and other wildlife professionals in Sabah are equipped with the knowledge and technical skills required for field surveillance and safe handling and sampling of wildlife and are also sensitized to animal mortality events that may represent a risk for viral spillover or disease emergence.

Summary of Surveillance and Field Activities for the Period Oct. 2014-Sept. 2015:

- Collected a total of 922 specimens from 78 animals (five bats, nine carnivores, 34 non-human primates, 30 other mammals); all samples will be entered into EDITH and tested in Year 2.
- Began Round 2 of Deep Forest sampling and collected 895 specimens from 129 animals (15 rodents and tree shrews, one other mammal, two carnivores, and 111 bats) at three sampling sites: Pristine 1 and Pristine 3.
- Began site surveys for additional Deep Forest sites in Kinabatangan and Beluran Districts; initiated planning for Round 2 of Human-Animal Contact Survey in Beluran District near Telupid.

Summary of Laboratory Development/Testing for the Period Oct. 2014-Sept. 2015:

- Performed confirmatory barcoding test on a subset of samples from PREDICT-1 where mismatched viral strains appeared; one tree shrew and one squirrel were confirmed to have squirrel Herpesviruses while a macaque was positive for Macacine herpesvirus, and an orangutan was confirmed negative for Macacine herpesvirus.
- Extracted another 108 Deep Forest surveillance swab samples collected in Quarter 4 of Year 1.
- Distributed field SOP, adapted from PREDICT sample collection protocols, to SWD and Danau Girang Field Centre (DGFC) to assist other projects.
- Tested remaining PREDICT-1 samples for Corona, Herpes, and Retro viruses at the WHGFL lab; results include the detection of known and novel herpesviruses including:
  - One new betaherpesvirus in a bat with no evidence to suggest public health threat.
  - One known and 15 novel strains of Herpesviruses in rodents with no evidence to suggest public health threat.
  - One known and six novel strains of Herpesviruses from non-human primates with no evidence to suggest public health threat.

- All results are sequence confirmed and have been cleared by the government for release.

Summary of Stakeholder Engagement and Partner Coordination for the Period Oct. 2014-Sept. 2015:

- Gave a presentation to the UN Special Rapporteur in Kota Kinabalu, Sabah on PREDICT.
- Discussed capacity building, sampling, and testing with SWD, DGFC, and the Department of State Health.
- Met with the new Director of SWD to discuss the project; as a result, SWD has committed to continued collaboration with PREDICT and approved release of all Sabah results to date on HealthMap (http://data.predict.global).
- Met with Deputy Director, Department of State Health, Sabah to discuss the project.

Other Activities this Period*:*

- Confirmed future SWD support for PREDICT-established lab, promoting sustainability.
- Revised the Wildlife Health Genetic and Forensic Laboratory (WHGFL) SOPs with SWD and DGFC for WHGFL re-certification; conducted emergency drills and generator procedures at WHGFL. WHGFL is the PREDICT diagnostic lab for Sabah, and its certification ensures that the Sabah Wildlife Department will be able to use it both for disease diagnostics and for their forensic work for wildlife crime investigaion/prosecution.
- Presented preliminary Human-Animal Contact Survey analysis to the communities of Sukau and Bilit.
- Discussed the project and provided WGHFL lab tour to University of Malaysia, Sabah faculty.
- Presented two talks at the 3rd International Southeast Asian Bat Conference in Kuching: “Bat viral diversity in different anthropogenic disturbance gradients in Kinabatangan, Sabah, Malaysia” and “Bat diversity survey at Lower Kinabatangan River Valley along a disturbance gradient.”
- Featured in Natural Geographic Channel production on “Wildest River”; a program about the Lower Kinabatangan Wildlife Sanctuary that featured the PREDICT team in the field sampling wildlife and the country coordinator discussing the PREDICT/Deep Forest surveillance projects.

Training Summary (Peninsular Malaysia and Sabah)

Topic	Total # Trained*	# Women Trained	# PREDICT Staff Trained	# Government Ministry or Lab Staff Trained	# Students Trained
Packing and shipping biological samples	3	0	0	3	0
Safe sample transport	38	2	0	37	0
Biosafety and PPE	67	17	0	61	5
Safe animal handling and sampling	48	4	0	37	6
Lab safety	37	1	2	37	0
Grand total	**82**	**23**	**2**	**67**	**6**

**Multiple individuals cross-trained in various topics.*

MONGOLIA

Highlights and Success Stories:

- Successfully conducted a scoping visit in June and July and held meetings with the USAID Mission, US Embassy, and representatives from potential Government of Mongolia partner agencies and laboratories.
- Selected and hired a Country Coordinator (Dr. Shiilegdamba Enkhtuvshin), a Mongolian veterinarian with a Masters in Preventive Veterinary Medicine from UC Davis and over 10 years of experience in the wildlife and public health sectors.
- Identified the State Central Veterinary Laboratory (SCVL), which operates under the Veterinary and Animal Breeding Agency (VABA) of the Ministry of Food and Agriculture (MoFA), as the most appropriate government and laboratory partner for the project's influenza-focused work in Mongolia; SCVL confirmed their strong interest to collaborate by re-initiating avian influenza surveillance in wild birds in Mongolia; the selection of SCVL was supported by the USAID Mission and the Epidemiology Department of VABA; confirmed MoFA support for SCVL to act as the governmental focal point for coordinating PREDICT biological surveillance and laboratory diagnostics in country.

Summary of Surveillance and Field Activities for the Period Oct. 2014-Sept. 2015:

- No surveillance or field activities were conducted in Mongolia in Year 1.
- Initiated planning for field surveillance in Year 2 and identified the Ornithology Laboratory of the Institute of Biology, Mongolian Academy of Sciences as a key partner for assessing and selecting avian influenza sampling sites for wild birds; an initial set of surveillance sites in Central and Eastern Mongolia were selected for more detailed assessments and pilot sampling in Year 2.
- Identified the National Center for Communicable Diseases (NCCD) within the Ministry of Health and Sports as the most relevant in-country human health sector stakeholder; formal collaboration between SCVL and NCCD outlined in a Memorandum of Understanding on zoonotic disease surveillance and diagnosis is currently in place, an existing collaboration between the animal and human health sectors that will be leveraged for project activities.

Summary of Laboratory Development/Testing for the Period Oct. 2014-Sept. 2015:

- Completed an initial assessment of the SCVL's capacity to implement PREDICT's viral detection and diagnostic protocols; the Transboundary Animal Disease (TAD) Laboratory within SCVL will be the designated laboratory for all diagnostics as this lab, which contains a Bio-Safety Level III facility and is staffed by trained virologists, conducts molecular diagnostic work, and has existing serological capacity.

Summary of Stakeholder Engagement and Partner Coordination for the Period Oct. 2014-Sept. 2015:

- Identified existing in-country influenza and ‘One Health’ networks, which currently have strong Ministry level representation from the human and animal health sectors and engagement of the environmental sector through the involvement of academic and research institutions and the NGO community.

MYANMAR

Highlights and Success Stories:

- Established a project office in Yangon and launched talent searches for a Country Coordinator, medical surveillance officer, and research scientist to develop an operational platform. Top candidates were identified for each position and include:
  - Country Coordinator – Prof. Tin Tin Myaing, current sitting president of the Myanmar Veterinary Association, Regional Veterinary Moderator at International Society for Infectious Diseases
  - Medical Surveillance Officer – Dr. Aung Than Toe, a medical doctor with extensive knowledge of social and governmental terrain in Myanmar
  - Research Scientist – Dr. Tierra Smiley-Evans, a veterinarian with both experience and published research in zoonotic disease surveillance
- The Yangon office will be the base of operations for Myanmar team members during drafting of agreements with local government, meetings with in-country collaborators, planning of surveillance activities, and coordination of program personnel.

Summary of Surveillance and Field Activities for the Period Oct. 2014-Sept. 2015:

- In collaboration with government, EPT partners, and regional PREDICT teams from China, Laos, and Thailand, developed preliminary surveillance plans targeting high-risk wildlife-human interfaces in Mingaladon Township, Mandalay Region and Tanintharyi Region near Dawei and began exploring opportunities for concurrent wildlife, livestock, and human sampling activities. Targeted sites include:
  - Mingaladon Township – a part of Myanmar's most populous geographical region which is experiencing increasing pig and poultry production with increased risk for domestic animal-human spillover. Additionally, this area contains the Hlwaga National Park with both forested and wetland/lake habitat, providing an opportunity for emergence of diseases associated with wildlife, including primates, bats, pangolins, and waterfowl.
  - Mandalay Region – reported to have bat roosts near caves where humans and macaques mingle, as well as bats, near domestic animal production, posing a potential high risk for cross-species transmission of numerous viral families.
  - Tanintharyi Region near Dawei – undergoing massive land use change as a major international road is constructed through previously undeveloped forest. Aside from road workers being potentially exposed to wildlife while clearing forest, food vendors in the construction zone frequently serve local wildlife, procured from the adjacent forest.

Summary of Laboratory Development/Testing for the Period Oct. 2014-Sept. 2015:

- Explored collaborations with key in-country laboratories, the Department of Medical Research, and the Livestock and Breeding Veterinary Diagnostics Laboratory and conducted preliminary assessments of lab capabilities to inform plans for operationalizing of viral detection activities and opportunities for training and capacity strengthening.

Summary of Stakeholder Engagement and Partner Coordination for the Period Oct. 2014-Sept. 2015:

- Initiated Letter of Agreement planning for the Myanmar Ministry of Planning that would enable coordination with several ministries, including the Ministry of Health; Ministry of Environmental Conservation and Forestry; and the Ministry of Livestock, Fisheries and Rural Development.

Other Activities this Period:

- Two team members, the Myanmar project lead and the IRB representative, both based at Smithsonian, completed training on Biomedical Human Subjects Research via the Collaborative Institutional Training Initiative (CITI) – the required Global-level training program for IRB activity oversight.

NEPAL

Highlights and Success Stories:

- Engaged government and key partner stakeholders at FAO, WHO, and all relevant government ministries to introduce EPT-2 and prioritize emerging pandemic threats surveillance and preparedness activities and strengthen One Health platforms in Nepal.
- Identified potential points for PREDICT support for disaster relief efforts following the 2015 earthquake. Contributions to the disaster response included producing and distributing informational disease outbreak prevention and risk communication materials (posters and brochures – Section 6), working with PREDICT partners at HealthMap to develop a digital disease detection and monitoring platform of health alerts and events to improve situational awareness of potential infectious disease threats (the site is publicly available at http://www.healthmap.org/nepal/).
- Recruited and trained seven new Nepali staff (four of them women), including a new project veterinarian, nurse, field staff, and lab team members, and integrated field and lab in-service training sessions for all staff incorporating new project protocols and surveillance guidance. Training sessions covered biosafety and PPE, lab safety, qualitative methods for behavioral risk investigations, safe animal handling and sampling, cold chain and safe sample transport, non-invasive collection of samples from non-human primates, sample processing, RNA extraction, viral family PCR testing, and information management. As a result, the team is now equipped with the knowledge and technical skills to initiate sample collection and testing resolving all remaining capacity gaps in technical expertise prior to implementation of surveillance and laboratory activities.
- Obtained permission from the Nepal Health Research Council (NHRC) to conduct qualitative behavioral research in Kathmandu to better understand perceptions of risk and practices that may be associated with zoonotic disease transmission in high-risk human communities. Began training of Nepali staff in qualitative behavioral research to allow full implementation in Year 2 concurrent with animal sampling at longitudinal surveillance sites to contextualize attitudes, beliefs, and motivations that influence behaviors at high-risk interfaces.

Summary of Surveillance and Field Activities for the Period Oct. 2014-Sept. 2015:

- Developed sampling strategy to integrate concurrent and longitudinal animal and human sampling at high-risk interfaces in Kathmandu at critical pathways of disease emergence and spread: 1) animal production intensification in vulnerable communities in urban landscapes and 2) land conversion for commercialization. The animal value chain pathway, and links to source and end users, was also evaluated to determine high-risk human activities in/around Chitwan National Park.
- Investigated human and animal surveillance opportunities and high-risk human animal contact, including pteropid bat consumption, among the Chepang ethnic

subgroup in Chitwan district where there is extraordinary biodiversity in an area facing ongoing landscape conversion and agricultural intensification.
- Evaluated clinical and hospital sites serving high-risk communities for syndromic surveillance of undiagnosed fevers of unknown origin, with special focus on severe acute respiratory disease and acute encephalitis in humans in Kathmandu and Chitwan districts.
- Collected 163 non-invasive saliva samples in July from macaques at the Sindhupalchowk and Pashupatinath temple complexes in Kathmandu to explore frequency and seasonality of viral shedding in an area with especially high-risk human-animal contact and extensive local and international tourism.

Summary of Laboratory Development/Testing for the Period Oct. 2014-Sept. 2015:
- Performed PREDICT-2 priority viral family screening on samples collected from macaques and collaborated with lab team at UC Davis to ensure optimized laboratory procedures and quality assurance in test results.
- Conducted an external evaluation of CMDN's current laboratory waste management system focusing on the optimizing and enhancing protocols for bio-hazardous waste management and handling of all hazardous materials and public health commodities to ensure programmatic compliance for laboratory activities in PREDICT-2.
- Enhanced the laboratory's long-term sample storage capacity with procurement of an additional ultra low freezer and supporting power backup.

Summary of Stakeholder Engagement and Partner Coordination for the Period Oct. 2014-Sept. 2015:
- Engaged relevant stakeholders to explore collaboration and coordination for concurrent human, livestock, and wildlife sampling activities with FAO Nepal, Central Veterinary Lab (CVL), Walter Reed / AFRIMS Research Unit Nepal (WARUN), WHO Nepal, Department of National Parks and Wildlife Conservation (DNPWC), and Patan Academy of Health Sciences (PAHS); new partnerships have been welcomed and pursued with appropriate implementing partners to facilitate surveillance activities, results reporting, and capacity strengthening.
- Hosted an interactive program in Kathmandu featuring PREDICT's Global Coordinator for Surveillance; the program engaged key stakeholders and participants from One Health-related fields to discuss emerging disease threats in Nepal.
- Played a central support role to the One Health Alliance, Nepal (OHAN) Network through meeting participation and facilitating interactive programs.

Other Activities this Period:
- To continue wildlife surveillance at sites prioritized for longitudinal surveillance, received extensions on research permits through the Ministry of Forestry and Soil and ongoing permission and support for surveillance activities from Kathmandu valley temples.

- Distributed reports summarizing PREDICT-1 findings and activities to USAID-Nepal and local departments within the Nepali government ministries (i.e. the Ministry of Health, the Ministry of Agriculture, and the Ministry of Forestry and Soil).
- Field veterinarians participated in a two-day training on wildlife sample collection and post mortem ungulate necropsy examination techniques facilitated by a US veterinarian in Chitwan, Nepal.
- Assessed displaced persons camps in the earthquake affected district of Sindhupalchowk and engaged with the local authorities and stakeholders in formulating a disease outbreak prevention program.

Training Summary

Topic	Total # Trained*	# Women Trained	# PREDICT Staff Trained	# Government Ministry or Lab Staff Trained	# Students Trained
Behavior risk	7	4	7	0	0
Safe sample transport	7	4	7	0	0
Biosafety and PPE	7	4	7	0	0
Safe animal handling and sampling	3	2	3	0	0
Viral detection and discovery	4	2	4	0	0
Total	**7**	**4**	**7**	**0**	**0**

**Multiple individuals cross-trained in various topics.*

THAILAND

Highlights and Success Stories:

- Published an article in *Virology Journal* entitled “Diversity of coronavirus in bats from Eastern Thailand” (Section 5: Wacharapluesadee et al., 2015).
- Detected the first human MERS-CoV case in Thailand; the MERS-CoV infection was first confirmed at the PREDICT lab at Chulalongkorn University, and viral family protocols were used to compare to the sensitivity of the WHO protocol. The result was reported to MOPH within eight hours with sequence confirmation following within 24 hours after receiving the specimen. The nasopharyngeal swab specimen collected on the same day and tested by other two Thai laboratories showed an inconclusive/negative result.
- Initiated screening of suspect Ebola patients arriving in Thailand using PREDICT protocols.

Summary of Surveillance and Field Activities for the Period Oct. 2014-Sept. 2015:

- Coordinated surveillance plans with partners at EPT-2 planning meeting in Bangkok.
- Discussed selection of longitudinal animal sampling sites in geographic concordance with existing human surveillance efforts with US CDC; planned for continued testing of human specimens using PREDICT laboratory protocols.
- Discussed triangulated surveillance with FAO and USAID RDMA to synchronize concurrent sampling of wildlife and domestic animals.
- Completed a site survey visit in Loei Province to explore opportunities for surveillance for human, livestock, and wildlife interfaces.
- Participated in the Global Health Security Agenda (GHSA) meeting in Bangkok, Thailand organized by the Thai government and U.S. Agencies (CDC, DTRA and USAID) to discuss strategies for implementing and coordinating GHSA activities in Thailand.
- Developed plan to identify points of contact at field sites for qualitative and/or quantitative human behavioral research to be implemented in Year 2.

Summary of Laboratory Development/Testing for the Period Oct. 2014-Sept. 2015:

- Tested 70 saliva samples from macaques collected at National Park during PREDICT-1 for Herpesviruses.
- Optimized the PCR protocol for amplifying whole spike of coronavirus from archived specimens from PREDICT-1.
- Conducted whole spike gene sequencing in nine samples, five were positive and four were negative; sequence analysis is ongoing to further characterize these viruses.
- Tested 50 specimens from human patients with unidentified cause of disease following routine testing using viral family protocols; viral families selected for testing were dependent on patient symptoms.

- Provided training on basic laboratory safety and completed PREDICT laboratory safety quiz for 10 laboratory staff who will participate in bat specimen collection (see Training Summary below).
- Organized the workshop “Ebola Diagnosis using real-time PCR” with support from the National Science and Technology Development Agency (NSTDA) in Thailand.
- Organized hands-on training workshop “Rabies diagnostic” for Sri Lankan participants and a separate workshop for Myanmar participants with funding support from WHO-SEARO.

Summary of Stakeholder Engagement and Partner Coordination for the Period Oct. 2014-Sept. 2015:

- Continued to engage key partners: Kasetsart University, Department of National Parks, Wildlife and Plant Conservation (Ministry of Natural Resources and Environment), Department of Livestock and Development (Ministry of Agriculture and Cooperatives), Department of Disease Control (Ministry of Public Health), Armed Forces Research Institute of Medical Sciences, Zoo Park Organization of Thailand, and Mahidol Universit, along with a number of local stakeholders and communities.
- Maintained extensive coordination with government and EPT partners, including FAO and CDC, especially with regard to planning for triangulated surveillance.

Other Activities this Period:

- Presented at “The future of knowledge and R&D” on Readiness, Prevention, and Resolution of Emerging Infectious Diseases, organized by Ministry of Public Health, Bangkok.
- Presented at the 22nd National Epidemiology Conference on “Conquering Emerging Infectious Diseases,” Bangkok.
- Presented poster on One Health surveillance in Thailand at the 3rd International One Health Congress, Amsterdam, Netherlands.
- Presented on “Laboratory Diagnosis Surge Capacity: Lab Capacity at Chulalongkorn University” at the Provisional Program for Review of National Ebola Virus Disease Preparedness, organized for representatives from WHO, WHO-SEARO and US-CDC by the Ministry of Public Health in Nonthaburi Province.
- Presented “Past, present and future of Ebola virus infection” at the Joint Conference in Medical Science 2015 in Bangkok.
- Presented on Coronaviruses in Thai bats at the “Viruses and Emerging Threat” meeting organized by the Thailand Research Fund (TRF).
- Presented (Country Coordinator) on “Diagnosing MERS-CoV safely and efficiently” while Prof. Hemachudha of Chulalongkorn University presented on “Clinical signs and contagiousness of MERS-CoV in humans” at NSTDA Knowledge Sharing of MERS, Thailand.
- Presented on “First imported case of MERS-CoV infection in Thailand” and poster on “Identification of Coronaviruses in Lyle’s flying fox (Pteropus lylei) in Thailand” at the Third International Congress on Pathogens at the Human-Animal

Interface (ICOPHAI) One Health for Sustainable Development, Chiang Mai, Thailand.

Training Summary

Topic	Total # Trained*	# Women Trained	# PREDICT Staff Trained	# Government Ministry or Lab Staff Trained	# Students Trained
Biosafety and PPE	10	7	9	0	0
Safe animal handling and sampling	10	7	9	0	0
Total	**10**	**7**	**9**	**0**	**0**

**Multiple individuals cross-trained in various topics.*

VIET NAM

Highlights and Success Stories:

- Formalized engagement with the Ministry of Health through the National Institute of Hygiene and Epidemiology (NIHE), Viet Nam's premiere infectious disease laboratory and research institute, with a series of introductory meetings followed by a small research exchange forum and culminating in the drafting of a Memorandum of Understanding (MoU) to support "Collaborative Investigation and Response to Infectious Diseases of Pandemic Potential at High Risk Wildlife/Human Interfaces in Viet Nam, as part of the USAID Emerging Pandemic Threats Program – PREDICT-2 Project, Viet Nam"; NIHE leadership was represented by the Deputy Director, who welcomed the new partnership and accepted the MoU, which will be signed in Year 2.
- USAID and the Ministry of Agriculture and Rural Development (MARD) signed an MoU on July 7, 2015, regarding the Emerging Pandemic Threats Program (EPT) and the Global Health Security Agenda (GHSA), expressing the intent of Participants to "implement the EPT-2 Program, to support the GHSA, and to help improve the technical capacity of relevant Government of Viet Nam ("GVN") entities and partners for the prevention, early identification, and response to dangerous pathogens in animals that may pose significant threats to human health".

Summary of Surveillance and Field Activities for the Period Oct. 2014-Sept. 2015:

- Extended the PREDICT-1 Memorandum of Agreement (MoA) with the Department of Animal Health (DAH) of the Ministry of Agriculture and Rural Development (MARD) through December 31, 2015, pending the completion of a new MoA for PREDICT-2 in Viet Nam; the extended MoA facilitates assessments of PREDICT-2 surveillance sites, opportunistic sampling of wildlife moving through the trade, and continued diagnostic work with laboratory partners; in addition the PREDICT-1 MoU with the Viet Nam National University of Agriculture (VNUA) was also extended through December 31, 2015, pending a new MoU for PREDICT-2, facilitating the storage and completion of diagnostic work on PREDICT-1 samples.
- Under the extended MoA, submitted reports of new PREDICT-1 diagnostic results to DAH in September and November 2014, and May 2015; data was approved for public release and is available online at http://data.predict.global.
- Targeted pangolins, traded in large volumes in the Southeast Asia region and often cited as the most trafficked mammal in the world, for surveillance along the wildlife trade and animal value chain emergence pathway; collected 334 samples (oral swabs, rectal swabs, feces and urine) from 79 individual pangolins over two sampling events in collaboration with the local NGO, Save Viet Nam's Wildlife, and Cuc Phuong National Park in Ninh Binh Province; all samples were transferred to the VNUA PREDICT laboratory for viral family testing planned for Year 2.

- Conducted site assessments in **t**he Southern Vietnamese province of Binh Phuoc, which borders Cambodia, as a possible focus for wildlife trade animal value chain surveillance; the province is known to be an important wildlife trade hub with wildlife moving across the border from Cambodia, consumed in local restaurants, and transported to Ho Chi Minh City and points to the north through distributers based in Binh Phuoc Province.

Summary of Laboratory Development/Testing for the Period Oct. 2014-Sept. 2015:

- Completed laboratory tours and initial laboratory assessments at the National Institute of Hygiene and Epidemiology (NIHE), the designated project laboratory for testing human samples in country.
- Screened 46 samples from common palm civets collected from wildlife farms during PREDICT-1 at the VNUA lab; the samples were screened for Flavivirus, Rhabdovirus, and Coronavirus using PREDICT protocols and for Canine Distemper Virus and Influenza A virus using VNUA standard protocols. PCR products were shipped to US-based reference labs for confirmation and sequencing in Year 2.
- Screened 459 rodent samples collected from wildlife farms during PREDICT-1 at the DAH Regional Animal Health Office No.6 (RAHO6) for Arenavirus, Paramyxovirus, Hantavirus, Bunyavirus, and Rhabdovirus. PCR products will be shipped to US-based reference labs for confirmation and sequencing in Year 2.
- Screened 22 non-human primate samples collected from wildlife farms during PREDICT-1 at UC Davis (the US-based reference lab) for Filovirus, Coronavirus, Paramyxovirus, Arenavirus, Influenza A, Rhabdovirus, Hantavirus, Alphavirus, Henipavirus, and Bunyavirus; two novel Rhabdoviruses were detected in saliva samples from two crab-eating macaques.
- Screened 393 bat samples and 1,771 rodent samples (originally tested at RAHO6 under PREDICT-1) for additional viral families (Bats: Filo-, Corona-, Arena-, Influenza-, Rhabdo-, Seadorna-, Henipa-, and Bunyavirus; Rodents: Corona-, Filo-, and Influenza virus) at the US-based reference lab; results are pending final interpretation, reporting to government, and approval for release.
- Prepared samples prioritized for further viral characterization for shipment to facilities in the US for next generation sequencing to fully characterize detected viruses and to determine any potential health impacts from known and novel viral agents.

Summary of Stakeholder Engagement and Partner Coordination for the Period Oct. 2014-Sept. 2015:

- Attended the ‘USAID Avian Influenza (AI) and EPT Partner Meeting’ at the USAID Mission in Hanoi and presented test results approved for public release; AI and EPT partners shared preliminary work plans and discussed opportunities for collaboration.
- Attended the ‘EPT-2 Viet Nam Launch and Work Planning Meeting’ organized by USAID Viet Nam and focused on identifying priorities for EPT-2 activities and clarifying opportunities for linkages and collaboration among partners; all EPT

partners joined the meeting, including MoH, MARD, FAO, WHO, UNDP, OHW, P&R, Partnership on Avian and Human Influenza (PAHI), and representatives from Viet Nam One Health University Network (VOHUN), VNUA, DAH, and CITES Management Authority.

- Conducted separate meetings with representatives of P&R and OHW in Hanoi to share contact information and plans for activities and engagement with government partners; also held a joint meeting with P&R and OHW to share updates during the GHSA Zoonotic Disease Action Planning (ZDAP) meeting in Hanoi.
- In collaboration with FAO, held a series of meetings to share surveillance plans and diagnostic approaches and to discuss EPT-2 collaboration; resulting discussions identified a range of interfaces where FAO and PREDICT could cooperate to carry out concurrent surveillance, including “wet markets” where live poultry and live rodents are sold, areas of intensive livestock production (poultry and swine) and international trade routes/borders (China-Viet Nam and Cambodia-Viet Nam); sites for potential concurrent sampling at the provincial level were also identified and included Soc Trang, Dong Thap, and Dong Nai Provinces and the greater Hanoi area.
- Held a series of informal “information sharing” meetings with WHO and CDC staff in Hanoi to clarify in-country programs related to surveillance for Severe Acute Respiratory Illness (SARI) and influenza.
- Attended and participated in three events linked to the launch of the GHSA in Viet Nam including a GHSA work planning meeting organized by the US CDC and USAID Mission, a GHSA Viet Nam Road Map meeting with government stakeholders, and an “International Conference on Zoonotic Disease Prevention and Control: Addressing Health Threats Posed by Zoonotic Diseases - Global Collaboration and Technical Exchange” that aimed to accelerate regional and international collaboration in support of the Zoonotic Disease Action Package.

Other Activities this Period*:*

- Received the “Best Poster” award for the presentation “Advancing wildlife disease surveillance in Viet Nam through cross sector collaboration” at the 7th annual meeting of the Asian Society of Zoo and Wildlife Medicine held in Tam Dao, Viet Nam in October 2014.
- Participated in the PAHI Secretariat-organized meeting of the ‘One Health Communication Network’ together with PREVENT, FAO, WHO, Viet Nam One Health University Network (VOHUN), Viet Nam National University of Agriculture (VNUA), CITES, Department of Animal Health (DAH), Viet Nam Farmers Union (VNU), and the MoH; all participants gave updates on ongoing and upcoming communication activities.
- Attended PREVENT’s “A Market Chain Analysis of the Cross-Border Rat Trade in Viet Nam and Cambodia: Research Findings Dissemination and Stakeholder Workshop” that convened participants directly involved in the rat trade (venders, traders, and transporters) and the local management agencies, such as the provincial sub-DAH offices; at the workshop, presented along with the Oxford University Clinical Research Unit (OUCRU) on research conducted to date in Viet

Nam on screening samples from rats for viruses of pandemic potential and known zoonotic pathogens.

- Attended the DAH "Veterinary Law Consultation Meeting" to provide comments on provisions related to wildlife health, biosecurity on wildlife farms, and the general importance of collaboration between the animal health and forestry/wildlife sectors in carrying out wildlife disease surveillance.
- Co-chaired the thematic session on the human/wildlife interface with the Viet Nam CITES Management Authority at the "3rd National One Health Conference: Infectious disease risks at the human-animal-ecosystem interface in Viet Nam", and presented a talk in the session highlighting the project's accomplishments in-country, including the achieved capacity for wildlife surveillance and results of laboratory diagnostic work.
- Attended, presented, and contributed ideas to a number of workshops/dialogues organized by PAHI and the Hanoi School Public Health's Center for Public Health and Ecosystem Research with an aim to share information about the project, zoonotic diseases, and wildlife trafficking as a driver of disease emergence and policy development to mitigate the risk of pandemic disease; at these platforms, emerging issues from the 3rd International One Health Congress Workshop in Amsterdam, ZDAP, and GHSA meetings were shared, and different mechanisms, like the One Health Roadmap, designed to coordinate work across projects and share information were identified. The workshops included:
  - 3rd International One Health Congress Follow-up Workshop: Prevention at Sources;
  - Policy Development Workshop - ECOnomic development, ECOsystem MOdifications, and emerging infectious diseases Risk Evaluation (ECOMORE);
  - One Health Roadmap and Matrix;
  - One Health Communication Network.

Training Summary

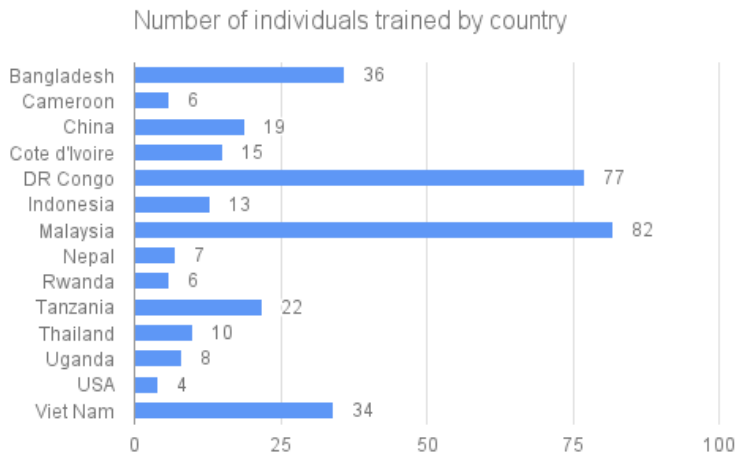
Topic	Total # Trained	# Women Trained	# PREDICT Staff Trained	# Government Ministry or Lab Staff Trained	# Students Trained
One Health Approach	34	9	0	16	0

IV. TRAINING SUMMARY

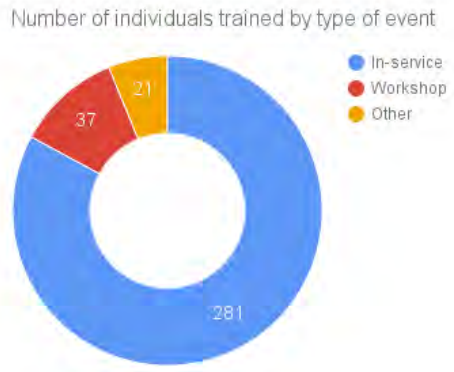
SECTION 4. PREDICT TRAINING SUMMARY

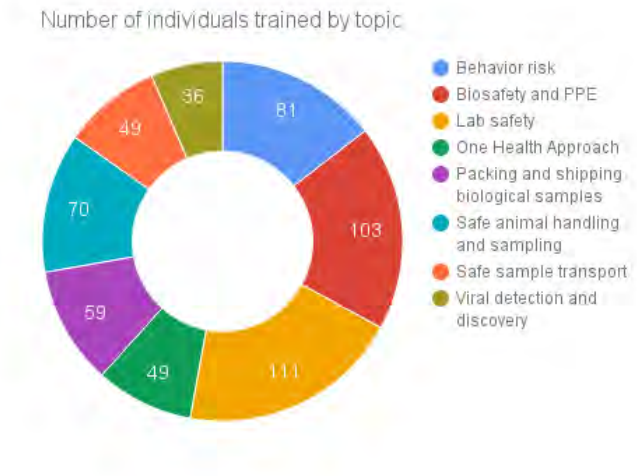
STRENGTHENING THE ONE HEALTH WORKFORCE

Preparing for emerging disease threats requires investments in infrastructure, institutions, and human resources across a broad array of health and social systems to operationalize One Health platforms. In collaboration with country governments and EPT partners, PREDICT is committed to developing the infrastructure and core skills and capabilities required by tomorrow's One Health workforce.



From October 1, 2014 to September 30, 2015, PREDICT teams around the world trained a total of 339 individuals, including 128 women and 205 government ministry or laboratory personnel, facilitating an extensive network of global One Health professionals to support long-term zoonotic disease surveillance. Trainings covered a variety of topics including: biosafety, ethics, field epidemiology and surveillance, information management, laboratory diagnostics, social sciences and behavioral risk investigations, and modeling and analytics.





PREDICT 2014-2015 Training Summary

Country	Topic	Total # Trained*	# Women Trained	# PREDICT Staff Trained	# Government Ministry or Lab Staff Trained	# Students Trained
Bangladesh	Behavior Risk	32	8	4	5	11
	Biosafety and PPE	6	0	2	4	0
	Safe Animal Handling and Sampling	3	0	2	1	0
	Bangladesh Total	**36**	**8**	**4**	**9**	**11**
Cameroon	Behavior Risk	1	1	1	0	0
	Lab Safety	5	1	5	0	0
	Information Management	4	1	4	0	0
	Ethics	1	0	0	0	0
	Cameroon Total	**6**	**1**	**6**	**0**	**0**
China	Behavior Risk	17	5	2	15	1
	Viral Detection and Discovery	1	1	0	1	0
	China Total	**19**	**6**	**3**	**16**	**1**
Cote d'Ivoire	PREDICT Basic Training*	15	6	0	15	0
	Cote d'Ivore Total	**15**	**6**	**0**	**15**	**0**
DR Congo	Behavior Risk	14	2	2	1	4
	Packing and Shipping Biological Samples	56	32	0	56	0
	Biosafety, PPE, and Safe Animal Handling and Sampling	2	0	0	2	0

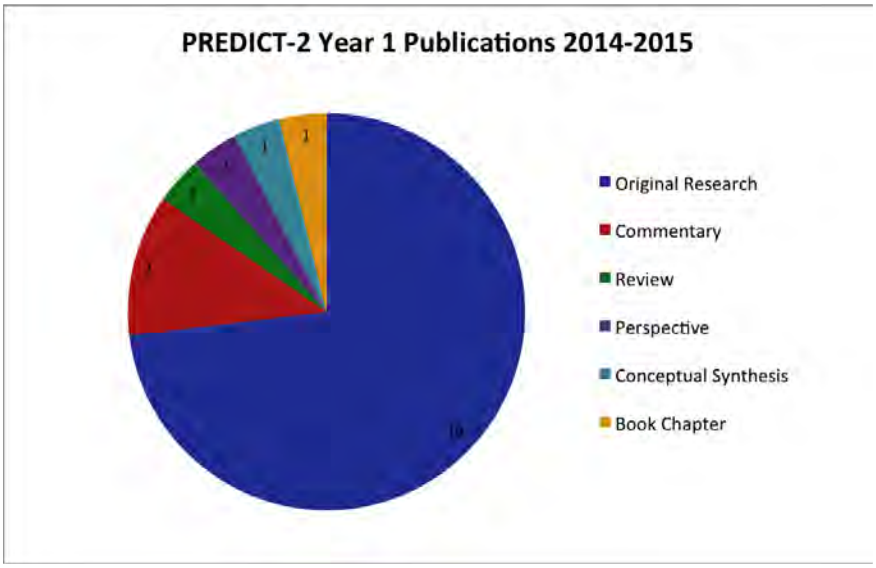
	Lab Safety	56	32	0	56	0
	Viral Detection and Discovery	7	2	0	7	0
	DR Congo Total	**77**	**36**	**2**	**66**	**4**
Indonesia	Behavior Risk	1	0	1	0	0
	Safe Sample Transport	1	0	1	0	0
	Biosafety and PPE	8	3	1	7	0
	Safe Animal Handling and Sampling	1	0	1	0	0
	Viral Detection and Discovery	13	4	1	11	1
	Indonesia Total	**13**	**4**	**1**	**11**	**1**
Malaysia	Packing and Shipping Biological Samples	3	0	0	3	0
	Safe Sample Transport	38	2	0	37	0
	Biosafety and PPE	67	17	0	61	5
	Safe Animal Handling and Sampling	48	4	0	37	6
	Lab Safety	37	1	2	37	0
	Malaysia Total	**82**	**23**	**2**	**67**	**6**
Nepal	Behavior Risk	7	4	7	0	0
	Safe Sample Transport	7	4	7	0	0
	Biosafety and PPE	7	4	7	0	0
	Safe Animal Handling and Sampling	3	2	3	0	0
	Viral Detection and Discovery	4	2	4	0	0
	Nepal Total	**7**	**4**	**7**	**0**	**0**
Rwanda	Lab Safety	6	1	1	5	0
	Viral Detection and Discovery	6	1	1	5	0
	Rwanda Total	**6**	**1**	**1**	**5**	**0**
Tanzania	One Health Approach	15	15	0	0	0
	Field Epidemiology	1	0	1	0	0
	Lab Safety	7	2	3	0	0
	Viral Detection and Discovery	5	2	1	0	0
	Tanzania Total	**22**	**17**	**3**	**0**	**15**

Thailand	Biosafety and PPE	10	7	9	0	0
	Safe Animal Handling and Sampling	10	7	9	0	0
	Thailand Total	**10**	**7**	**9**	**0**	**0**
Uganda	Behavior Risk	5	3	2	0	2
	Safe Sample Transport	3	1	0	0	3
	Biosafety and PPE	3	1	0	0	3
	Safe Animal Handling and Sampling	3	1	0	0	3
	Uganda Total	**8**	**4**	**2**	**0**	**5**
USA	Behavior Risk	4	2	4	0	0
	USA Total	**4**	**2**	**4**	**0**	**0**
Viet Nam	One Health Approach	34	9	0	16	0
	Viet Nam Total	**34**	**9**	**0**	**16**	**0**
Grand Total		**339**	**128**	**44**	**205**	**43**

V. PUBLICATION SUMMARIES

SECTION 5. PREDICT PUBLICATION SUMMARIES

This past year, PREDICT research led to 24 publications, including 19 original research articles, many in top-tier journals like *Nature, Emerging Infectious Diseases, Proceedings of the National Academy of Sciences,* and *The Lancet*. Summaries of publications are provided below, highlighting practical implications for the scientific, policy, and development sectors. A comprehensive bibliography with all PREDICT publications to date may be found online at: http://www.vetmed.ucdavis.edu/ohi/predict/predict_publications.cfm



ORIGINAL RESEARCH

Non-random patterns in viral diversity

Authors: S.J. Anthony, A. Islam, C.K. Johnson, I. Navarrete-Macias, E. Liang, K. Jain, P.L. Hitchens, X. Che, A. Soloyov, A.L. Hicks, R. Ojeda-Flores, C. Zambrana-Torrelio, W. Ulrich, M.K. Rostal, A. Ptrosov, J. Garcia, N. Haider, N.D. Wolfe, T. Goldstein, S.S. Morse, M. Rahman, J.H. Epstein, J.K. Mazet, P. Daszak, and W.I. Lipkin.

In brief: The threat that infectious diseases increasingly pose to both public health and economic stability has excited efforts to establish a predictive understanding of emergence. One area of 'prediction' that would be particularly useful is the ability to forecast how viral diversity might respond to environmental drivers of disease emergence, for example land-use change. However, to date, it has been unclear whether or not changes in viral diversity are inherently predictable. This study investigated whether viral communities in macaques from Bangladesh were influenced by predictable (deterministic) or random (stochastic) forces. The authors collected fecal samples from rhesus macaque monkeys at nine locations across Bangladesh and used both consensus PCR and high-throughput sequencing to identify a total of 184 unique

viruses. Statistical analyses of the differences and similarities in strains within and among macaque groups suggested that deterministic forces had affected patterns of viral diversity at different scales, both between sites and within individuals. The authors also showed that the effects of determinism were not absolute, as stochastic (unpredictable) patterns were observed. In conclusion, determinism was shown to be an important process in viral community assembly and that it should be possible to forecast changes to some portion of a viral community, though there will always be a portion for which prediction will be unlikely.

To better communicate the findings of this study, the authors produced a website (www.letspredictviruses.com) that allows visitors to explore some of these concepts, combining an interactive narrative and a challenging retro-style puzzle game that casts viruses as Space Invaders. LetsPredictViruses.com explains two of the patterns governing viral communities included in this paper: *dependence*—when one kind of virus cannot replicate in a host without the presence of a different virus; and *exclusion*—when the presence of one virus excludes another. The video game challenges visitors to spot these patterns in seven levels of increasing difficulty, and is designed to try and reach a broad and diverse audience

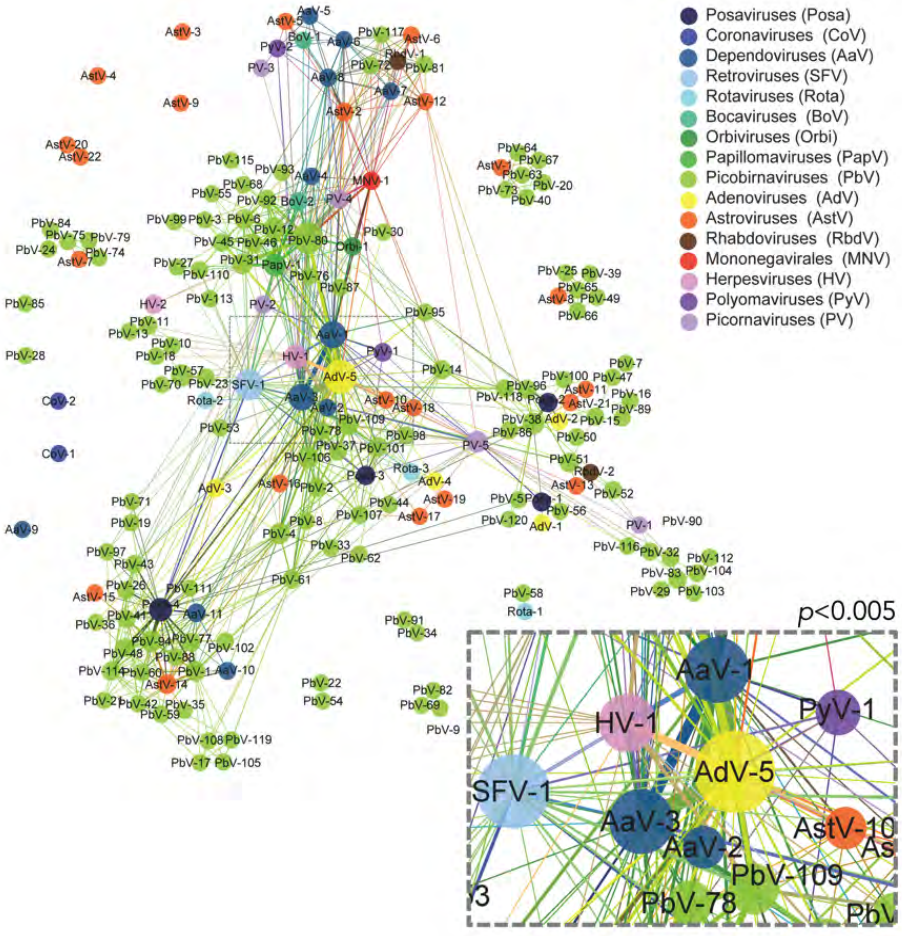


Figure: One-mode affiliation network demonstrating the frequency of viral co-occurrence in the same host. Viruses (colored by family/genus) are linked if found in the same individual. Frequency of co-occurrence indicated by thickness of the edge connecting each node. Insert shows significant (C-score p<0.05) co-occurrence of AaVs with AdV and HV (significance determined using PAIRS).

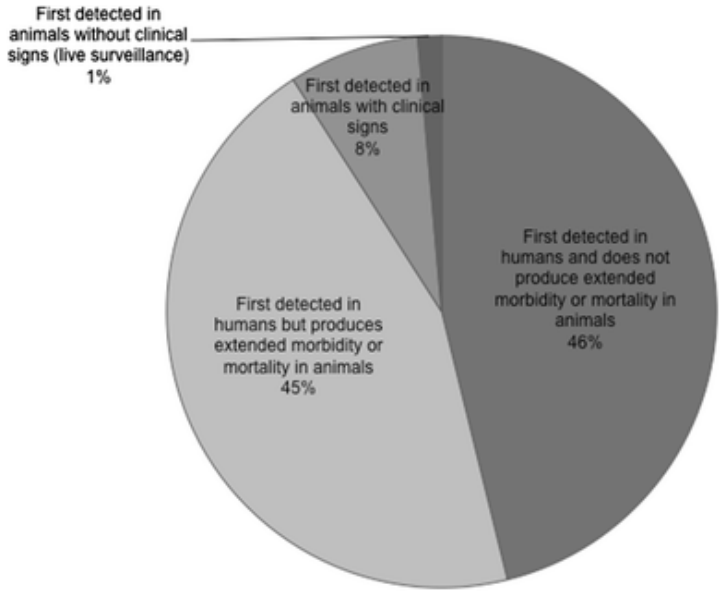
Source: Anthony et al., 2015.

Citation: Anthony, S.J., A. Islam, C.K. Johnson, I. Navarrete-Macias, E. Liang, K. Jain, P.L. Hitchens, X. Che, A. Soloyov, A.L. Hicks, R. Ojeda-Flores, C. Zambrana-Torrelio, W. Ulrich, M.K. Rostal, A. Ptrosov, J. Garcia, N. Haider, N.D. Wolfe, T. Goldstein, S.S. Morse, M. Rahman, J.H. Epstein, J.K. Mazet, P. Daszak, W.I. Lipkin. 2015. Non-random patterns in viral diversity. *Nature Communications* 6:8147. Available online: http://www.nature.com/ncomms/2015/150922/ncomms9147/abs/ncomms9147.html

Early detection of emerging zoonotic diseases with animal morbidity and mortality monitoring

Authors: I. Bisson, B. Ssebide, and P.P. Marra.

In brief: Zoonotic disease transmission continues to affect both animal and human populations globally, with over 50% of emerging infectious human diseases originating in animals and costs estimated at $20-200 billion between 2000-2010. This study assessed emerging diseases that were first discovered through morbidity or mortality reports in animal hosts over a 64-year time period. An analysis of 143 pathogens found that 45% of human outbreaks due to zoonotic pathogens could have benefitted from early detection in animals. This study highlights the importance of an active animal surveillance system that includes reporting on livestock and wildlife morbidity and mortality with passive sampling of live animals who may be asymptomatic reservoirs as an effective method to identify potential zoonotic disease emergence. The authors note a current lack of public health platforms that include animal sampling and recommend both active and passive animal surveillance to enhance zoonotic disease surveillance. Such an approach could provide benefits to public health, animal health, and wildlife conservation due to improved rapid response capacity for diseases in animals and people.



The proportion and location of disease detection. Source: Bisson et al., 2014.

Citation: Bisson, I., B. Ssebide, P.P. Marra. 2014. Early detection of emerging zoonotic diseases with animal morbidity and mortality monitoring. *EcoHealth* 12(1): 98-103. Available online: http://link.springer.com/article/10.1007/s10393-014-0988-x/fulltext.html

Human herpes simplex virus type 1 in confiscated gorilla

Authors: K. Gilardi, K. Oxford, D. Gardener-Roberts, J.F. Kinani, L. Spelman, P. Barry, M. Cranfield, and L. Lowenstine.

In brief: A major concern of the conservation community is the transmission of human viruses to endangered or threatened animals and the potential impacts of human diseases on the health and population of endangered wildlife. In 2007, an illness was detected in five confiscated eastern lowland gorillas (Grauer's gorilla) that were housed in a facility in the Democratic Republic of Congo. All of the affected gorillas presented with lethargy, anorexia, and oral lesions. A biopsy and oral swab was taken from a four-year old female gorilla for analysis and it was determined that the illness was caused by Human Herpes Simplex Virus Type 1 (HSV-1). According to the authors, the transmission of HSV-1 from humans to gorillas was most likely due to human-gorilla and/or gorilla-gorilla contact at the facility. While HSV-1 has been reported in other captive gorillas, it has not been detected in wild gorilla populations. For the rehabilitation and conservation community, the implications of human viral spillover to captive wildlife, like these gorillas, is significant and should be considered in planning for reintroduction of captive animals to protect endangered wild populations from the introduction of new pathogens. To reduce spillover risk for endangered wild gorillas, the authors emphasize the need for complete health screens of human pathogens in captive animals when considering reintroduction.

A captive gorilla and caretaker bonding in the Democratic Republic of Congo. All gorilla caretakers protect the gorillas from human microbes and diseases like HSV-1 by wearing personal protective equipment like masks and gloves. Source: Gorilla Doctors.

Citation: Gilardi, K., K. Oxford, D. Gardener-Roberts, J.F. Kinani, L. Spelman, P. Barry, M. Cranfield, L. Lowenstine. 2014. Human herpes simplex virus type 1 in confiscated gorilla. *Emerging Infectious Diseases* 20(11). Available online: http://wwwnc.cdc.gov/eid/article/20/11/14-0075_article

Detection of diverse novel astroviruses from small mammals in China

Authors: B. Hu, A.A. Chmura, J. Li, G. Zhu, J.S. Desmond, Y. Zhang, W. Zhang, J.E. Epstein, P. Daszak, and Z. Shi.

In brief: Astroviruses have been detected in humans and many animal species worldwide, especially in rodents and bats. To investigate the prevalence, genetic diversity, ecology, and evolution of astroviruses, this study conducted surveillance for astroviruses from 39 different species of small mammals in the Hainan, Guanxi, and Yunnan provinces of Southern China. New astroviruses were detected in species that were otherwise unknown, with notable high genetic diversity in the kachin red-backed vole. The detection of diverse astroviruses among many small mammal species, including the first detection in shrews and pikas, illustrates the importance of systematic surveillance of wildlife as reservoirs in large geographic areas to broaden our understanding of the evolution and distribution of astroviruses and other emerging and zoonotic viruses.

Citation: Hu, B., A.A. Chmura, J. Li, G. Zhu, J.S. Desmond, Y. Zhang, W. Zhang, J.E. Epstein, P. Daszak, Z. Shi. 2014. Detection of diverse novel astroviruses from small mammals in China. *Journal of General Virology* 95: 2442-2449. doi: 10.1099/vir.0.067686-0

Molecular evidence of Ebola Reston virus infection in Philippine bats

Authors: S.I. Jayme, H.E. Field, C. de Jong, K.J. Olival, G. Marsh, A.M. Tagtag, T. Hughes, A.C. Bucad, J. Barr, R.R. Azul, L.M. Retes, A. Foord, M. Yu, M.S. Cruz, I.J. Santos, T.M.S. Lim, C.C. Benigno, J.H. Epstein, L.F. Wang, P. Daszak, and S.H. Newman.

In brief: Reacting to the detection of Reston ebolavirus (RESTV) in domestic pigs and farmers in the Philippines (2008-2009), this study explored bats in the Philippines as possible wildlife reservoirs for RESTV. A total of 464 total bats from 21 species were sampled from two sites in Luzon and tested using molecular (qPCR) and serological (Western blot and ELISA) diagnostics for RESTV. Samples from the common bent-wing bat detected RNA in throat swabs and molecular tests suggest RESTV presence in three additional bat species. Serological tests detected anti-RESTV antibodies in the giant golden-crowned flying fox. Samples resulted in RESTV genetic sequences that varied from the strain detected in pigs and farmers. Results indicate that the ebolavirus is taxonomically widespread in the Philippines. However, this study detected a low ebolavirus prevalence and viral load. The authors recommend expanding future research geographically and taxonomically to better understand the ecology of RESTV

in the Philippines and to inform policy to reduce RESTV spillover from bats to livestock and humans.

Sample processing with the Philippine team at a site in Bulacan Provinces in Luzon. Source: EcoHealth Alliance.

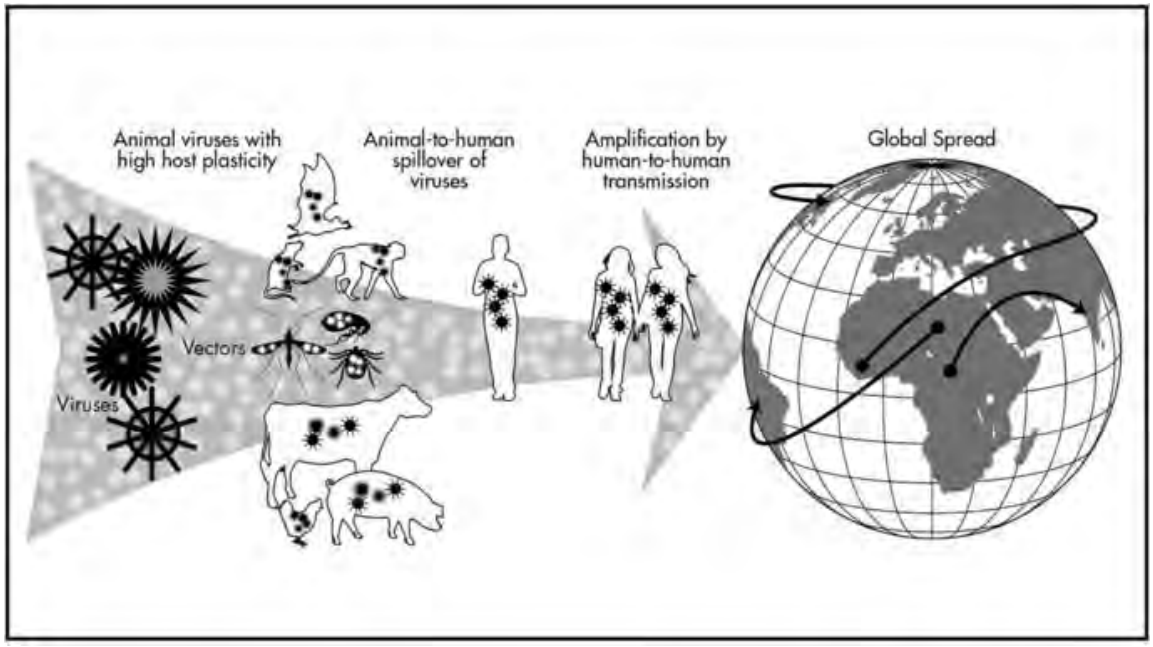
Citation: Jayme, S.I., H.E. Field, C. de Jong, K.J. Olival, G. Marsh, A.M. Tagtag, T. Hughes, A.C. Bucad, J. Barr, R.R. Azul, L.M. Retes, A. Foord, M. Yu, M.S. Cruz, I.J. Santos, T.M.S. Lim, C.C. Benigno, J.H. Epstein, L.F. Wang, P. Daszak, S.H. Newman. 2015. Molecular evidence of Ebola Reston virus infection in Philippine bats. *Virology Journal* 12:107. Available online: http://virologyj.biomedcentral.com/articles/10.1186/s12985-015-0331-3

Spillover and pandemic properties of zoonotic viruses with high host plasticity

Authors: C.K. Johnson, P.L. Hitchens, T. Smiley Evans, T. Goldstein, K. Thomas, A. Clements, D.O. Joly, N.D. Wolfe, P. Daszak, W.B. Karesh, and J.A.K. Mazet.

Most human infectious diseases, especially recently emerging pathogens, originate from animals, and ongoing disease transmission from animals to people presents a significant global health burden. Recognition of the epidemiologic circumstances involved in zoonotic virus spillover, amplification, and spread is essential for prioritizing surveillance and predicting future disease emergence risk. This study examined the animal hosts and transmission mechanisms involved in spillover of zoonotic viruses to date, and

discovered that viruses with high host plasticity (i.e. taxonomically and ecologically diverse host range) were more likely to amplify viral spillover by secondary human-to-human transmission and have broader geographic spread. Viruses are more likely to be transmitted to humans during practices that facilitate mixing of diverse animal species, such as wild animals sold at markets, kept as pets, or maintained in sanctuaries and zoos. Animal-to-human spillover of new viruses that are capable of infecting diverse host species signal emerging disease events with higher pandemic potential in that these viruses are more likely to amplify by human-to-human transmission with spread on a global scale. Heightened surveillance, particularly at high-risk animal-human interfaces in settings with diverse host assemblages that have been under-reported to date, is essential for directing us towards critical control points and behavior change interventions aimed at disease prevention.



Pandemic properties of zoonotic viruses that spill over from animals to humans and spread by secondary transmission among humans, evaluated here for associations with viral traits and high-risk disease transmission interfaces. Source: Johnson et al., 2015.

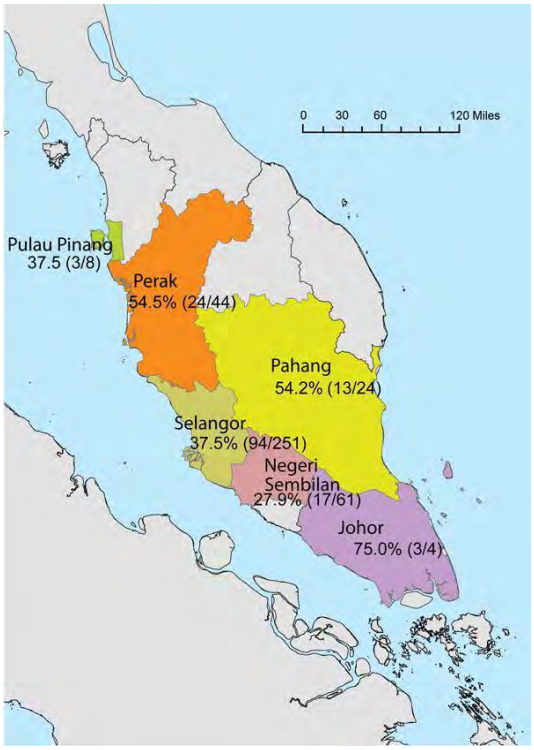
Citation: Johnson, C.K., P.L. Hitchens, T. Smiley Evans, T. Goldstein, K. Thomas, A. Clements, D.O. Joly, N.D. Wolfe, P. Daszak, W.B. Karesh, J.A.K. Mazet. 2015. Spillover and pandemic properties of zoonotic viruses with high host plasticity. *Nature Scientific Reports* 5:14830. Available online: http://www.nature.com/articles/srep14830

Macacine herpesvirus 1 in long-tailed macaques, Malaysia, 2009-2011

Authors: M.H. Lee, T. Hughes, M.K. Rostal, F. Sitam, C.Y. Lee, J. Japning, M.E. Harden, A. Griffiths, M. Basir, J. H. Epstein, N.D. Wolfe, and P. Daszak.

In brief: Macacine herpesvirus 1 (MaHV1; B virus) naturally infects macaques and can be fatal in people, yet very little is known about infection in people outside of lab settings.

Macaques have adapted to urbanized human environments and contact between people, and macaques can occur in a variety of contexts like feeding and population management programs. This study describes the context of potential MaHV1 transmission between macaques and people during the capture and transport of long-tailed macaques in a population management program implemented in Peninsular Malaysia. After capture, samples from 392 macaques were tested for MaHV1 DNA using PCR. Overall, 39% of macaques were shedding MaHV1 DNA. Shedding patterns of MaHV1 among the macaques were explored and suggest that a substantial proportion of animals shed the MaHV1 virus after and potentially during transport, a factor that may be caused by the stress of relocation and which may elevate the risk of exposure to MaHV1 by wildlife personnel or other animal handlers involved in relocation activities. To reduce risk of infection, the authors recommend that appropriate personal protective equipment (PPE) like respirators, gloves, and eye protection be provided for all individuals handling macaques or other wildlife in these circumstances. As a result, the Government of Malaysia Department of Wildlife and National Parks is strengthening its existing policies to require all personnel to wear appropriate PPE, to use proper work area biosafety and disinfection techniques, and to provide training to protect workers and reduce transmission risks; practices that promote the prevention of transmission events for MaHV1 and other potentially dangerous zoonotic pathogens.



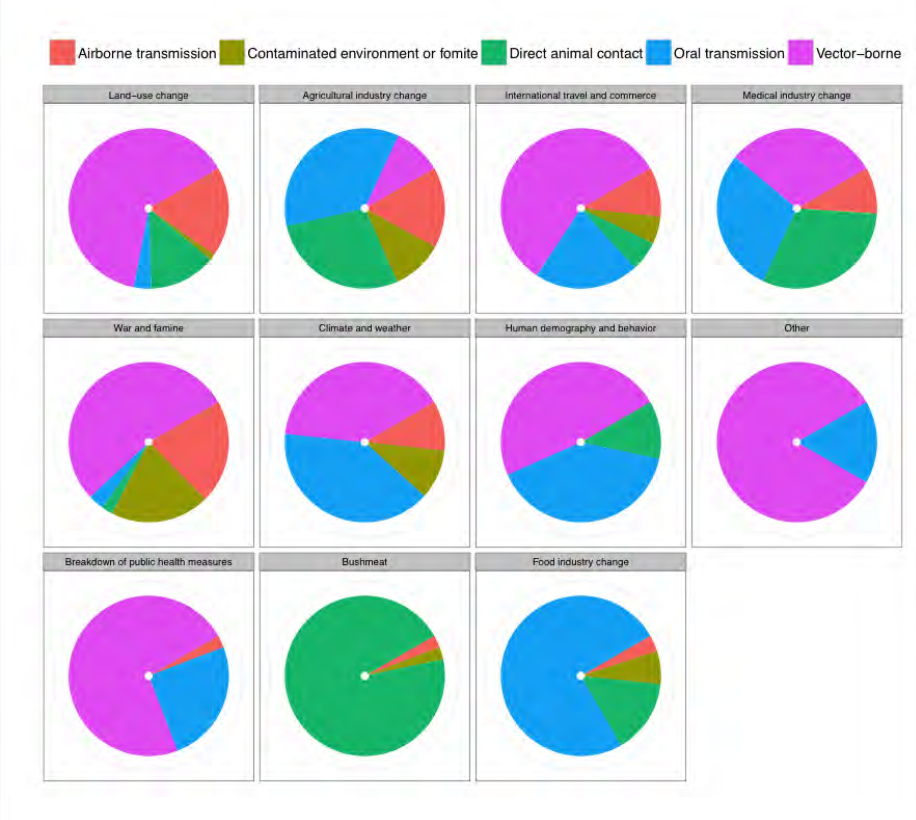
Map of the state of origin and prevalence of macacine herpesvirus 1 shedding within sampled groups of macaques (the number positive/total tested) from Peninsular Malaysia, September 2009-July 2011. Source: Lee et al., 2015.

Citation: Lee, M.H., T. Hughes, M.K. Rostal, F. Sitam, C.Y. Lee, J. Japning, M.E. Harden, A. Griffiths, M. Basir, J. H. Epstein, N.D. Wolfe, P. Daszak. 2015. Macacine herpesvirus 1 in long-tailed macaques, Malaysia, 2009-2011. *Emerging Infectious Diseases* 21(7). Available online: http://wwwnc.cdc.gov/eid/article/21/7/14-0162_article

Targeting transmission pathways for emerging zoonotic disease surveillance and control

Authors: E.H. Loh, K.J. Olival, C. Zambrana-Torrelio, T.L. Bogich, C. Kreuder-Johnson, J.A.K. Mazet, W.B. Karesh, and P. Daszak.

In brief: Factors ranging from agriculture to war can lead new infectious diseases to spillover from the environment into humans and cause disease outbreaks. In addition, humans can acquire infectious diseases through a number of different pathways, such as through vectors (e.g., mosquitoes) or by direct exposure to infectious body tissues or fluids. Are any of these pathways more likely than others to transmit one or more serious diseases? To answer this question, the authors reviewed scientific literature and analyzed a database of all reported emerging infectious diseases (EIDs) to rank the importance of different transmission pathways in different EID settings. Findings suggest that overall the likelihood of transmission through any given pathway is roughly equal to transmission through another. The authors did find, however, that certain factors leading to spillover events or EID drivers, such as changes in land use from forest and wildlife habitat to agricultural use were significantly linked with particular transmission pathways. These findings are particularly relevant for the design of prevention strategies targeting the spillover of new infectious diseases into humans.



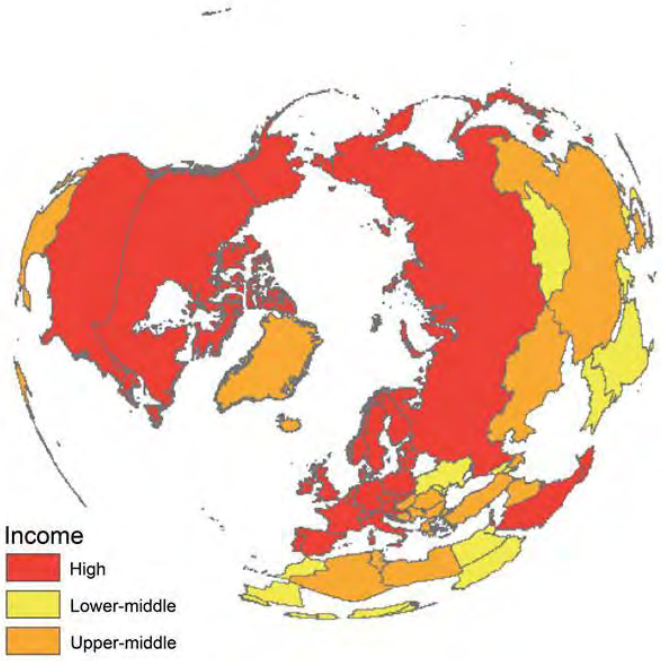
Scaled number of zoonotic emerging infectious diseases (EID) events (n = 145) per transmission route categorized by the primary driver of disease emergence for each pathogen. To calculate which pathways were associated with each EID driver, the authors split the data into subsets by driver, summed the weightsfor each transmission category, and divided the sum by the total number of EID events per driver. Source: Loh et al., 2015.

Citation: Loh, E.H., C. Zambrana-Torrelio, K.J. Olival, T.L. Bogich, C.K. Johnson, J.A.K Mazet, W. Karesh, and P. Daszak. 2015. Targeting transmission pathways for emerging zoonotic disease surveillance and control. *Vector-Borne and Zoonotic Diseases* 15(7): 432-437. doi:10.1089/vbz.2013.1563.

Global avian influenza surveillance in wild birds: A strategy to capture viral diversity

Authors: C. Machalaba, S.E. Elwood, S. Forcella, K.M. Smith, K. Hamilton, K.B. Jebara, D.E. Swayne, R.J. Webby, E. Mumford, J.A.K. Mazet, N. Gaidet, P. Daszak, and W.B. Karesh.

In Brief: Wild birds play a major role in the evolution, maintenance, and spread of avian influenza viruses. However, surveillance for these viruses in wild birds is sporadic, geographically biased, and often limited to the last outbreak virus. To identify opportunities to optimize wild bird surveillance for understanding viral diversity, the authors reviewed responses to a World Organization for Animal Health (OIE)–administered survey, government reports to the OIE, articles on Web of Knowledge, and the Influenza Research Database. At least 119 countries conducted avian influenza virus surveillance in wild birds during 2008-2013, but coordination and standardization was lacking among surveillance efforts, and most focused on limited subsets of influenza viruses. Given high financial and public health burdens of recent avian influenza outbreaks, the authors call for sustained, cost-effective investments in locations with high avian influenza diversity in wild birds and efforts to promote standardized sampling, testing, and reporting methods, including full-genome sequencing and sharing of isolates with the scientific community.



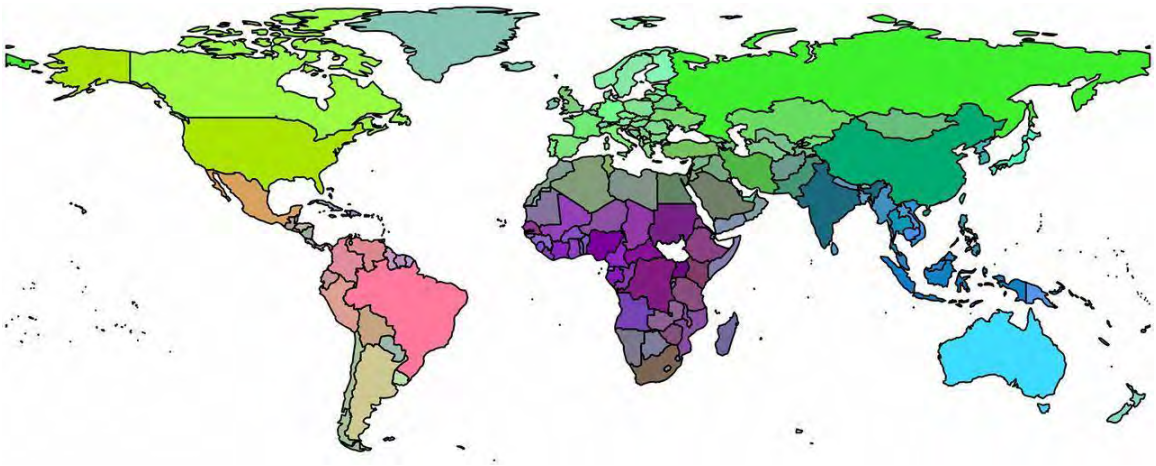
Countries in red, orange, and yellow currently self-report some type of avian influenza surveillance in wild birds, suggesting feasibility of coordinating and improving avian influenza surveillance in wild birds in regions where viral diversity is highest. Source: Machalaba et al., 2015.

Citation: Machalaba, C., S.E. Elwood, S. Forcella, K.M. Smith, K. Hamilton, K.B. Jebara, D.E. Swayne, R.J. Webby, E. Mumford, J.A.K. Mazet, N. Gaidet, P. Daszak, W.B. Karesh. 2015. Global avian influenza surveillance in wild birds: A strategy to capture viral diversity. *Emerging Infectious Diseases* 21(4). Available online: http://wwwnc.cdc.gov/eid/article/21/4/pdfs/14-1415.pdf

Global biogeography of human infectious disease

Authors: K.A. Murray, N. Preston, T. Allen, C. Zambrana-Torrelio, P.R. Hosseini, and P. Daszak.

In brief: Understanding the distributions of infectious diseases is a central public and global health objective. In this study, the authors analyzed the global occurrence patterns of 187 human infectious diseases across 225 countries and seven epidemiological classes (human-specific, zoonotic, vector-borne, nonvector-borne, bacterial, viral, and parasitic) to show that human infectious diseases exhibit distinct spatial grouping patterns at a global scale. The authors use outbreaks of Ebola virus to illustrate how such patterns could be leveraged to provide a “head start” or added focus for risk management activities. Findings show that human infectious diseases exhibit striking biogeographic grouping patterns at a global scale, reminiscent of “Wallacean” zoogeographic patterns. This result is surprising, given the global distribution and unprecedented connectivity of humans as hosts and the homogenizing forces of globalization; despite these factors, infectious disease assemblages remain fundamentally constrained in their distributions by ecological barriers to dispersal or establishment. Biogeographic processes thus appear to provide an overarching context in which other factors promoting infectious disease emergence and spread are set.



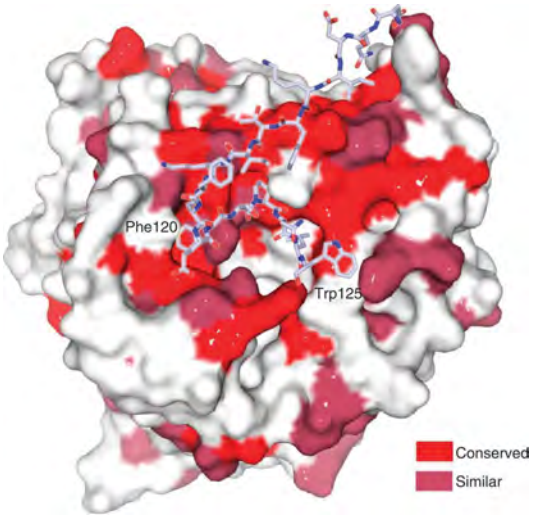
Global human infectious disease pathogeographic patterns. Source: Murray et al., 2015.

Citation: Murray, K.A., N. Preston, T. Allen, C. Zambrana-Torrelio, P.R. Hosseini, and P. Daszak. 2015. Global biogeography of human infectious disease. *PNAS* 12(41): 12746-12751. Available online: http://www.pnas.org/content/112/41/12746.abstract

Evidence of henipavirus spillover into human populations in Africa

Authors: O. Pernet, B.S. Schneider, S.M. Beaty, M. LeBreton, T.E. Yun, A. Park, T.T. Zachariah, T.A. Bowden, P. Hitchens, C.M. Ramirez, P. Daszak, J. Mazet, A.N. Freiberg, N.D. Wolfe, and B. Lee.

In brief: Paramyxoviruses are a part of the henipavirus genus, which includes the highly pathogenic Nipah and Hendra viruses that have a historically high mortality rate of >90% during outbreaks on the Asian and Australian continents. The natural reservoirs for henipaviruses are wild fruit bats that cover a large geographic range, including sub-Saharan Africa. To explore potential zoonotic spillover, this study examined fruit bat (*Eidolon helvum*) (n=44) and human (n=497) blood serum samples from Cameroon and examined factors, such as occupation, deforestation, and hunting/butchering activities, to determine if a specific behavior/activity was associated with henipavirus spillover. Of the 497 humans sampled, 171 reported butchering bats, and a seroprevalence rate of 4% (7/171) was detected for henipavirus in human serum samples. Butchering bats was a risk factor for seroprevalence. Additionally, the seroprevalence rate of henipavirus in sampled fruit bats was 48% (21/44). This study indicates that there may be spillover of henipaviruses into people engaged in the high-risk activity of butchering fruit bats in Cameroon. Due to the high diversity of henipaviruses detected in Africa, the widespread distribution of the reservoir host, and the prevalence of risky activities in the bushmeat trade, the study indicates risk of henipavirus spillover and illness in human populations. To counter this threat, the authors recommend additional surveillance of fruit bat and high-risk human populations, international collaborations to improve monitoring of henipaviruses across a wider geographic space, cross-disciplinary approaches, and bushmeat trade regulations to track and ultimately control henipavirus spillover in Africa.



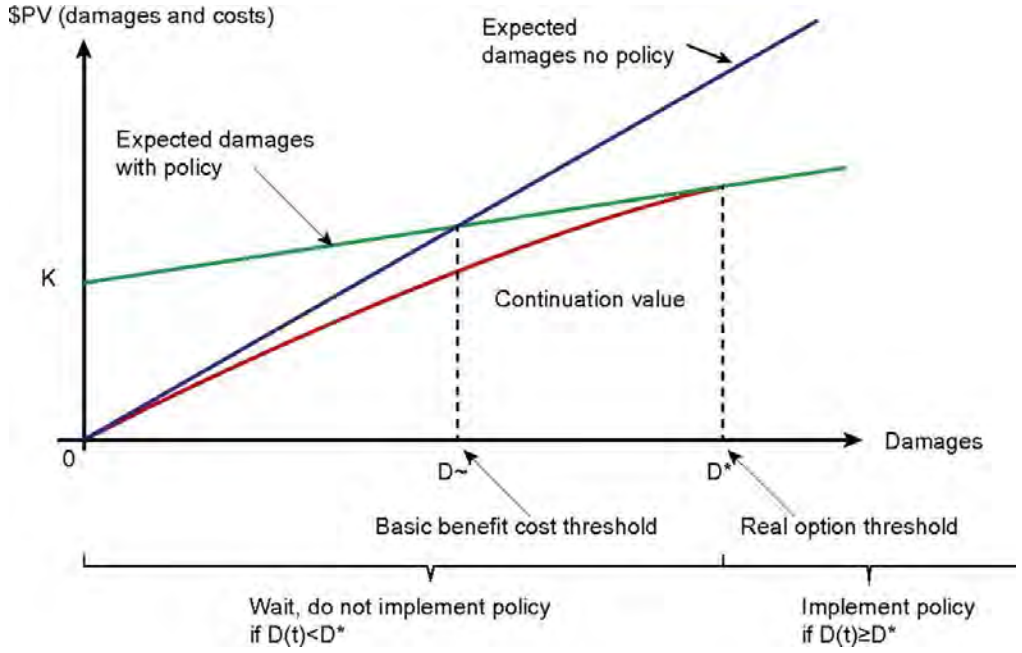
A model of the Nipah virus surface compared for conserved and similar sections of the henipavirus detected in the study (Bat Paramyxovirus Eid_hel/GH-M74a/GHA/2009). Source: Pernet et al., 2014.

Citation: Pernet, O., B.S. Schneider, S.M. Beaty, M. LeBreton, T.E. Yun, A. Park, T.T. Zachariah, T.A. Bowden, P. Hitchens, C.M. Ramirez, P. Daszak, J. Mazet, A.N. Freiberg, N.D. Wolfe, B. Lee. 2014. Evidence of henipavirus spillover into human populations in Africa. *Nature Communications* 5:5342. Available online: http://www.nature.com/ncomms/2014/141118/ncomms6342/full/ncomms6342.html

Economic optimization of a global strategy to address the pandemic threat

Authors: J. Pike, T.L. Bogich, S.E. Elwood, D.C. Finnoff, and P. Daszak.

In brief: Emerging pandemics are increasing in frequency, threatening global health and economic growth. Global strategies to thwart pandemics can be classed as adaptive (reducing impact after a disease emerges) or mitigation oriented (reducing the causes of pandemics). Through economic analysis, the authors show that the optimal time to implement a globally coordinated adaptive policy is within 27 years and that given geopolitical challenges around pandemic control, these should be implemented with urgency. Furthermore, authors find that mitigation policies aimed at reducing the likelihood for disease emergence are more cost effective, and if implemented today could result in savings between $344-361 billion over the next 100 years.



Real option model to determine the optimal timing for reducing emerging infectious diseases; where K=cost and D=threshold in which policy should be implemented. Source: Pike et al., 2015.

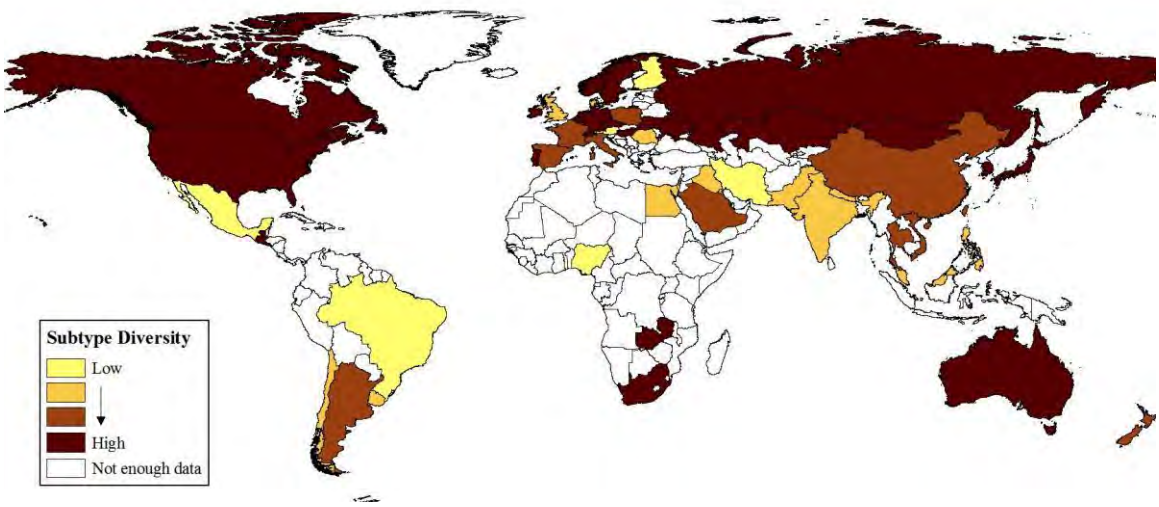
Citation: Pike, J., T.L. Bogich, S.E. Elwood, D.C. Finnoff, P. Daszak. 2014. Economic optimization of a global strategy to address the pandemic threat. *PNAS* 111(52): 18519-18523. Available online: http://www.pnas.org/content/111/52/18519.abstract

Evolutionary dynamics and global diversity of influenza A virus

Authors: D. Rejmanek, P.R. Hosseini, J.A.K. Mazet, P. Daszak, and T. Goldstein.

In brief: In recent years, an increasing number of influenza A virus (IAV) subtypes including H5N1, H7N9, and H10N8 have been detected in humans. Their high fatality

rates have led to an increased urgency to better understand where and how novel pathogenic influenza strains emerge. Our findings showed that mutational rates of 11 commonly encountered subtypes were higher in East Asian countries compared to those in North America, suggesting there may be a greater risk for the emergence of novel pathogenic strains in East Asia. In assessing the potential drivers of IAV subtype diversity, our analyses confirmed that reporting effort and healthcare spending were the best predictors of observed subtype diversity at the country level. These findings underscore the need to increase sampling and reporting efforts for all subtypes in many under-sampled countries throughout the world such as African, Eastern European and Latin American countries with limited influenza data.



Map of influenza A sub-type diversity. Source: Rejmanek et al., 2015.

Citation: Rejmanek, D., P.R. Hosseini, J.A.K. Mazet, P. Daszak, and T. Goldstein. 2015. Evolutionary dynamics and global diversity of influenza A virus. *Journal of Virology* 89(21):10993-11001. doi: 10.1128/JVI.01573-15.

Evaluation of local media surveillance for improved disease recognition and monitoring in global hotspot regions

Authors: J.S. Schwind, D.J. Wolking, J.S. Brownstein, PREDICT Consortium, J.A.K. Mazet, and W.A. Smith.

In brief: Digital disease detection and early warning systems have increased the rate and geographic coverage of disease event information collection and dissemination. However, digital disease detection has limitations. This research explored the potential for alternative data collection methods to enhance digital surveillance reach through the integration of local media surveillance (LMS). Local print media sources reporting broadly on health or events relevant to disease events or health outcomes were targeted for LMS by PREDICT teams in five low and middle income countries. Results show that LMS can enhance digital surveillance systems by filling gaps in network coverage and by contributing valuable localized information to global databases. Through LMS, 87 unique health events were reported during the 16-week monitoring period including 71

unique reports not detected in the digital network used for comparison (HealthMap). While multiple opportunities were identified to improve operation and efficiency of the LMS approach, this pilot study supports the promotion of LMS as a low cost tool to support digital disease detection systems by closing information gaps in areas with minimal digital surveillance coverage, including many 'hot-spot' regions for emerging infectious diseases.

Conceptual model of a local media surveillance system to close information gaps with digital disease surveillance systems in remote areas or areas with limited Internet connectivity. Source: Schwind et al., 2014.

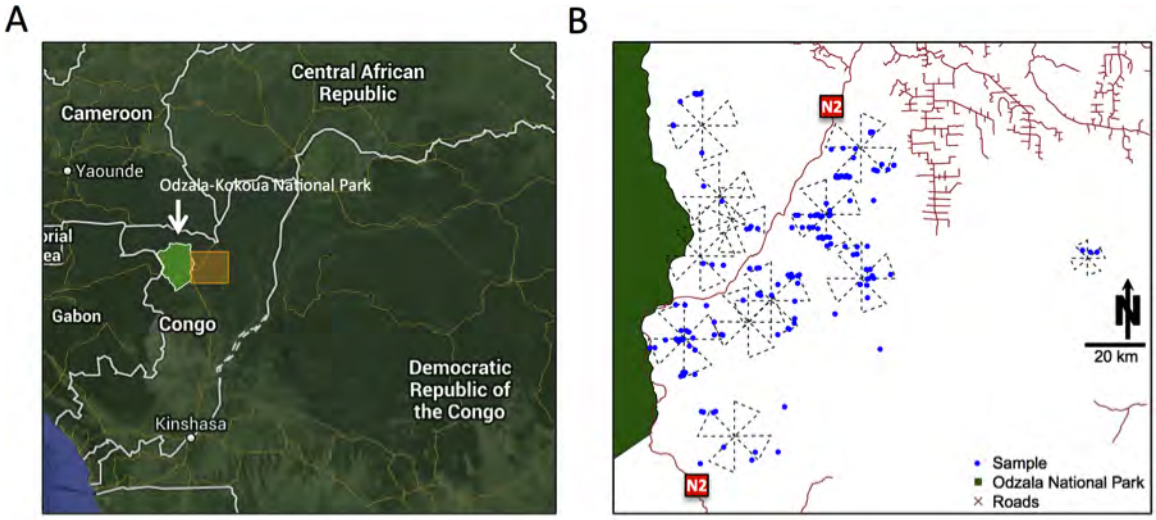
Citation: Schwind, J.S., D.J. Wolking, J.S. Brownstein, PREDICT Consortium, J.A.K. Mazet, W.A. Smith. 2014. Evaluation of local media surveillance for improved disease recognition and monitoring in global hotspot regions. *PLOS One* 9(10): e110236. Available online: http://journals.plos.org/plosone/article?id=10.1371/journal.pone.0110236

Adenovirus and herpesvirus diversity in free-ranging great apes in the Sangha region of the Republic of Congo

Authors: T. Seimon, S. Olson, K.J. Lee, G. Rosen, A. Ondzie, K. Cameron, P. Reed, S. Anthony, D. Joly, W. Karesh, D. McAloose, and W.I. Lipkin.

In brief: Infectious diseases have caused die-offs in both free-ranging gorillas and chimpanzees. Understanding pathogen diversity and disease ecology is therefore critical for conserving these endangered animals. The goals of this study were to investigate the diversity of viruses in free-ranging gorillas and chimpanzees from the Sangha region of the Republic of Congo and estimate viral richness in these populations through pathogen detection in fecal samples. Samples were analyzed to determine ape species, identify individuals in the population, and to test for the presence of viruses. The authors identified 19 DNA viruses representing two viral families, Herpesviridae and Adenoviridae, of which three herpesviruses had not been previously described. Co-detections of multiple herpesviruses and/or adenoviruses were present in both gorillas

and chimpanzees. Cytomegalovirus (CMV) and lymphocryptovirus (LCV) were found primarily in the context of co-association with each other and adenoviruses. Using viral discovery curves for herpesviruses and adenoviruses, the total viral richness in the sample population of gorillas and chimpanzees was estimated to be a minimum of 23 viruses, corresponding to a detection rate of 83%. These findings represent the first description of DNA viral diversity in feces from free-ranging gorillas and chimpanzees in or near the Odzala-Kokoua National Park and form a basis for understanding the types of viruses circulating among great apes in this region.



Map of the Republic of Congo (A) showing the location of Odzala-Kokoua National Park (arrow) and the study area (yellow box); The 12 sites (B) where the samples were collected with blue dots showing where each sample was collected and crosses showing the extent of the survey sites. Source: Seimon et al., 2015.

Citation: Seimon, T., S. Olson, K.J. Lee, G. Rosen, A. Ondzie, K. Cameron, P. Reed, S. Anthony, D. Joly, W. Karesh, D. McAloose, and W.I. Lipkin. 2015. Adenovirus and herpesvirus diversity in free-ranging great apes in the sangha region of the Republic of Congo. *PLOS One* 10(3): e118543. Available online: http://journals.plos.org/plosone/article?id=10.1371/journal.pone.0118543

Optimization of a novel non-invasive oral sampling technique for zoonotic pathogen surveillance in nonhuman primates

Authors: T. Smiley Evans, P.A. Barry, K.V. Gilardi, T. Goldstein, J.D. Deere, J. Fike, J. Yee, B.J. Ssebide, D. Karmacharya, M.R. Cranfield, D. Wolking, B.R. Smith, J.A.K. Mazet, and C.K. Johnson.

In brief *(from original abstract):* Wild nonhuman primates are frequent sources of pathogens that could be transmitted to humans because primates are closely genetically related to humans and have direct contact with people in many parts of the world. Sampling primates to screen for diseases is challenging because standard invasive sampling techniques, such as the collection of a blood sample or an oral swab, requires field anesthesia of the animal. This research describes a non-invasive oral sampling technique that involves distributing a rope for primates to chew on that can be retrieved

and screened for pathogens. Oral samples were successfully collected from multiple wild primate species in remote field settings and viruses were detected in those samples. This non-invasive sampling method has the potential for future applications in disease studies examining primates as sources of infections that could affect humans in remote high-risk settings, and is now being utilized in the field as a low cost and safe method for diseases monitoring of nonhuman primates in many “hot spot” regions for emerging viruses throughout the world.

A L’hoest’s monkey in Bwindi Impenetrable Forest region, Uganda chews on one of the oral swab ropes with attached retrieval string. Swabs like these are a low cost and safe way to screen wild primates for pathogens. Source: Smiley Evans et al., 2015.

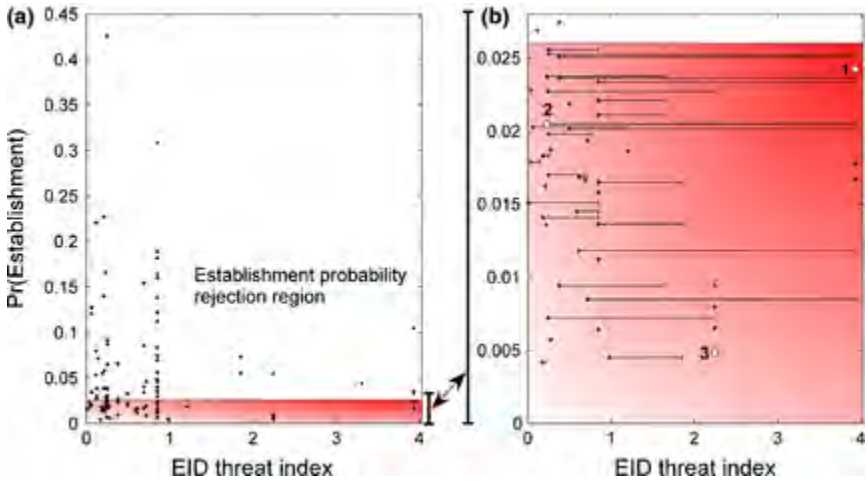
Citation: Smiley Evans, T., P.A. Barry, K.V. Gilardi, T. Goldstein, J.D. Deere, J. Fike, J. Yee, B.J. Ssebide, D. Karmacharya, M.R. Cranfield, D. Wolking, B.R. Smith, J.A.K. Mazet, C.K. Johnson. 2015. Optimization of a Novel Non-invasive Oral Sampling Technique for Zoonotic Pathogen Surveillance in Nonhuman Primates. Rimoin A, ed. *PLoS Neglected Tropical Diseases* 9(6): e0003813. Available online: http://journals.plos.org/plosntds/article?id=10.1371/journal.pntd.0003813.

Integrating invasion and disease in the risk assessment of live bird trade

Authors: M. Springborn, R.P. Keller, S. Elwood, C.M. Romagosa, C. Zambrana-Torrelio, and P. Daszak.

In brief: The international trade in plants and animals is a highly lucrative economic enterprise but is not without costs, as demonstrated by the impacts of invasive species on ecosystems and the introduction of diseases affecting people, livestock, wildlife and the environment. Because current policy responses address the adverse consequences and damage caused by invasive species and international agreements for control and

trade target only species with known impacts, this study aimed to develop a rapid risk assessment tool to estimate the likelihood that a traded bird species would cause negative environmental and health impacts if imported into the United States. Using a two-step rapid risk assessment approach that, once developed, can be completed for a species in a matter of days, the authors construct a model of emerging infectious disease threat and then illustrate how the tool can be utilized to identify and prioritize species for regulation. This framework is the first to quantitatively assess expected biological risks due to both environmental and health impacts of a potentially invasive traded wildlife species. In addition, by nesting this risk assessment tool in a cost-benefit-derived decision making framework, the tool enables determination of whether biological risks are justified by trade benefits.



Species plotted by EID threat index versus probability of establishment, Pr(Establishment). Source: Springborn et al., 2015.

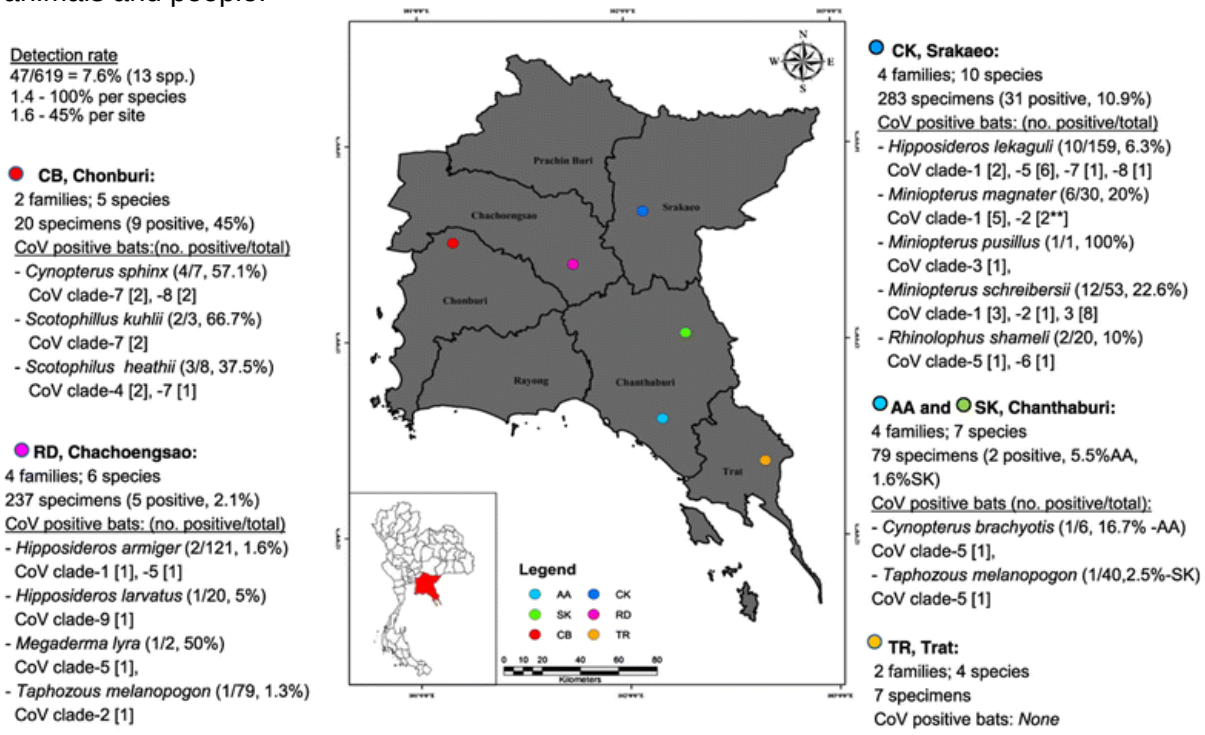
Citation: Springborn, M., R.P. Keller, S. Elwood, C.M. Romagosa, C. Zambrana-Torrelio, P. Daszak. 2015. Integrating invasion and disease in the risk assessment live bird trade. *Diversity and Distributions* 21(1): 101-110. Available online: http://onlinelibrary.wiley.com/doi/10.1111/ddi.12281/full

Diversity of coronavirus in bats from Eastern Thailand

Authors: S. Wacharapluesadee, P. Duengkae, A. Rodparn, T. Kaewpom, P. Maneeorn, B. Kanchanasaka, S. Yinsakmongkon, N. Sittidetboripat, C. Chareesaen, N. Khlangsap, A. Pidthong, K. Leadprathom, S. Ghai, J.H. Epstein, P. Daszak, K.J. Olival, P.J. Blair, M.V. Callahan, and T. Hemachudha.

In brief: Bats are reservoirs for a diverse range of coronaviruses (CoVs), including those closely related to human pathogens such as Severe Acute Respiratory Syndrome (SARS) CoV and Middle East Respiratory Syndrome CoV. There are approximately 139 bat species reported to date in Thailand, of which two are native species that only occur in Thailand, many other species are also found in neighboring countries in Southeast Asia. Due to the disease potential of CoVs, standardized surveillance efforts to characterize viral diversity in wildlife are imperative. In this study, 626 bats from 19

different bat species were individually sampled from five provinces in Eastern Thailand between 2008 and 2013. CoV RNA was detected in 47 specimens (7.6%), from 13 different bat species, using broadly reactive consensus PCR. Thirty-seven alphacoronaviruses, nine lineage D betacoronaviruses, and one lineage B betacoronavirus (SARS-CoV related) were identified, along with six new bat CoV reservoirs. In addition, CoVs from the same genetic lineage were found in different bat species roosting in similar or different locations. These findings suggest that bat CoV lineages are not strictly concordant with their hosts and that there is high diversity and complex ecology of CoVs in bats sampled from specific areas in eastern regions of Thailand. Further characterization of additional CoV genes may be useful to better describe the CoV divergence, which would enhance our understanding and ability to develop prevention and control strategies for CoVs that may present health risks to animals and people.



Locations where bats were sampled including detection rates for coronaviruses. Source: Wacharapluesadee et al., 2015.

Citation: Wacharapluesadee S., P. Duengkae, A. Rodpan, T. Kaewpom, P. Maneeorn, B. Kanchanasaka, S. Yinsakmongkon, N. Sittidetboripat, C. Chareesaen, N. Khlangsap, A. Pidthong, K. Leadprathom, S. Ghai, J.H. Epstein, P. Daszak, K.J. Olival, P.J. Blair, M.V. Callahan, T. Hemachudha. 2015. Diversity of coronavirus in bats from Eastern Thailand. *Virology Journal* 12(57). Available online: http://www.ncbi.nlm.nih.gov/pmc/articles/PMC4416284/

Mild influenza A/H7N9 infection among children in Guangdong province

Authors: X. Zheng, W. Mai, B. Shu, L. Yi, J. Lu, T. Song, H. Zhong, H. Xiao, D. Guan, J. Wu, L. Liang , C. Monagin , X. Zhang, and C. Ke.

In brief: This study examined seven case studies from the 2013-14 novel avian-origin reassorted influenza A (H7N9) outbreak in Guangdong province, China. Authors describe clinical and epidemiological characteristics for seven children to expand the knowledge on human reactions to H7N9 and to benefit early detection for improved influenza surveillance systems. Recorded clinical signs included fever, throat congestion, cough, rhinorrhea, and upper respiratory infection. Collection and analysis of environmental samples reflected data collected on case source, geographic location, symptom onset, and environmental exposures of the case studies. Poultry markets and residences of the children in the case studies were targeted for potential environmental contamination, and environmental samples from Zhongshan city (25%) and Zhaoqing city (44.3%) tested positive for H7N9. This study highlights children as a high-risk population for influenza and asymptomatic H7N9 carriers and provides sanitation recommendations on for behavioral modifications to disinfect high-risk environments for influenza.

Citation: Zheng, X., W. Mai, B. Shu, L. Yi, J. Lu, T. Song, H. Zhong, H. Xiao, D. Guan, J. Wu, L. Liang, C. Monagin, X. Zhang, C. Ke. 2014. Mild influenza A/H7N9 infection among children in Guangdong province. *Pediatric Infectious Disease Journal* 34(1). doi: 10.1097/INF.0000000000000492

REVIEW

Reservoir host immune responses to emerging zoonotic viruses

Authors: J.N. Mandl, R. Ahmed, L. Barreiro, P. Daszak, J.H. Epstein, H.W. Virgin, and M.B Feinberg.

In brief: Zoonotic pathogens can cause significant disease in humans while seeming to cause relatively insignificant disease in their original reservoir hosts. How do hosts and viruses establish equilibria that lead to decreased or negligible signs of disease? Information on the immunological responses that a virus' reservoir host has to viral infection is key to understanding the characteristics of infection, the nature of host-viral equilibria, and the likelihood of disease transmission to other animals, including other species. In this article, the authors reviewed existing scientific literature on immune functions affecting susceptibility to, tolerance of, and the transmission of viral zoonotic infections. Information from this review identified additional areas of research that together will improve the targeting of future efforts to prevent or diminish the impact of emerging viral diseases.

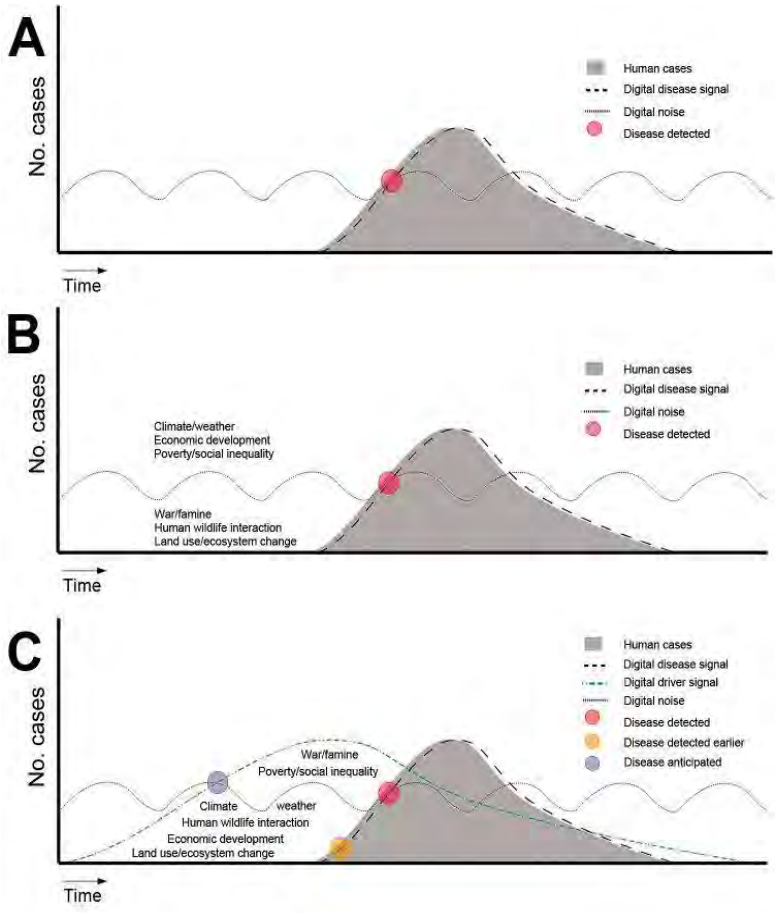
Citation: Mandl, J.N., R. Ahmed, L. Barreiro, P. Daszak, J.H. Epstein, H.W. Virgin, M.B Feinberg. 2015. Reservoir host immune responses to emerging zoonotic viruses. *Cell* 160(1-2): 20-35. doi: http://dx.doi.org/10.1016/j.cell.2014.12.003

PERSPECTIVE

Drivers of emerging infectious disease events as a framework for digital detection

Authors: S.H. Olson, C.M. Benedum, S.R. Mekaru, N.D. Preston, J.A.K. Mazet, D.O. Joly, and J.S. Brownstein.

In brief: Scientists aim to improve the efficacy and timeliness of infectious disease outbreak prediction. Here, the authors suggest that the varied and overlapping conditions ("drivers") leading to disease outbreaks can and should be monitored for signals that suggest outbreaks are likely. Further, the authors propose that drivers of disease emergence and their signals can be measured and digitally analyzed to enhance this "epidemic intelligence," just as meteorologists use weather data to predict storms. This article reviews the limitations of existing global disease driver data, considers the merits of existing disease data technology solutions, and proposes ideal features of future driver monitoring systems. In the building of a disease surveillance platform capable of identifying and describing drivers of infectious diseases, indicating key driver thresholds, and predicting relationships among drivers, the authors view digital disease surveillance as an obtainable and worthy goal capable of leading, in turn, to improvements in active disease surveillance and the prevention and control of infectious disease outbreaks.



Surveillance and detection of disease by traditional (A, B) and digital (C) detection systems. Source: Olson et al., 2015.

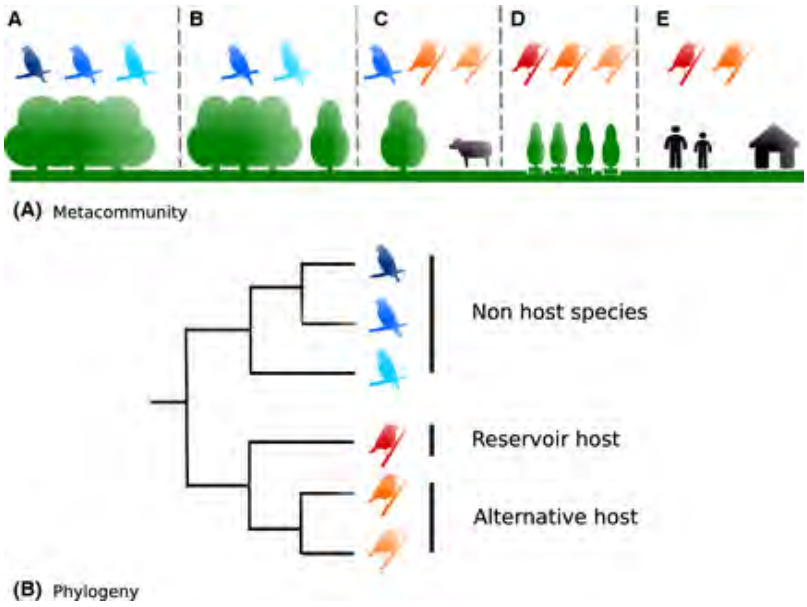
Citation: Olson, S.H., C.M. Benedum, S.R. Mekaru, N.D. Preston, J.A.K. Mazet, D.O. Joly, J.S. Brownstein. 2015. Drivers of Emerging Infectious Disease Events as a Framework for Digital Detection. *Emerging Infectious Diseases* 21(8) Available online: http://wwwnc.cdc.gov/eid/article/21/8/14-1156_article.

CONCEPTUAL SYNTHESIS

Metacommunity and phylogenetic structure determine wildlife and zoonotic infectious disease patterns in time and space

Authors: G. Suzán, G.E. García-Peña, I. Castro-Arellano, O. Rico, A.V. Rubio, M.J. Tolsá, B. Roche, P.R. Hosseini, A. Rizzoli, K.A. Murray, C. Zambrana-Torrelio, M. Vittecoq, X. Bailly, A.A. Aguirre, P. Daszak, A-H. Prieur-Richard, J.N. Mills, and J-F. Guégan.

In brief: Most studies on the ecology of zoonotic diseases caused by pathogens hosted by wildlife reservoirs and vectors (hosts) focus at the level of local populations and communities and the environment in which these interactions occur. Very few consider dimensions at larger scales, such as the landscape and regions that play an important role in infectious disease dynamics. Disease ecology studies using a metacommunity framework can provide novel insights into the mechanisms of emergence of infectious diseases in wildlife including human zoonoses. The authors contribute to the understanding of landscape-level disease dynamics, by proposing a conceptual model of three plausible mechanisms that may influence these dynamics. This conceptual model is a first step in establishing a metacommunity approach to infectious disease transmission. The authors suggest that changes in dispersal, colonization, local extinctions, and biotic interactions resulting from changes in land use and ecosystem alteration can filter and drive patterns of species distribution that subsequently can shape reservoir, vector, and infectious disease occurrences. Importantly, these patterns can be mechanistically and spatially modeled with potentially large benefits for disease management. Furthermore, as the portfolio of infectious disease spread and spatial distribution in metacommunities expands, public health professionals will be better able to evaluate the factors that predispose both a time and place to the origin and emergence of an infectious disease outbreak. This fundamental understanding will help improve the health of humans, wildlife, and domestic animals by mitigating the processes that drive the diversity of infectious disease threats we currently face and will continue to face into the future. Because this study represents the first step in establishing a metacommunity approach to infectious disease transmission, additional mathematical models and empirical studies are needed to further understand the relevance and influence of metacommunities on infectious disease outbreaks and spread.



Conceptual model of ecological and evolutionary relationships within communities that regulate prevalence of infection with a zoonotic pathogen in the reservoir host. Source: Suzán et al., 2015.

Citation: Suzán, G., G.E. García-Peña, I. Castro-Arellano, O. Rico, A.V. Rubio, M.J. Tolsá, B. Roche, P.R. Hosseini, A. Rizzoli, K.A. Murray, C. Zambrana-Torrelio, M. Vittecoq, X. Bailly, A.A. Aguirre, P. Daszak, A-H. Prieur-Richard, J.N. Mills, and J-F. Guégan. 2015. Metacommunity and phylogenetic structure determine wildlife and zoonotic infectious disease patterns in time and space. *Ecology and Evolution* 5(4): 865-873. Available online: http://onlinelibrary.wiley.com/doi/10.1002/ece3.1404/abstract

COMMENTARY

Beyond Ebola: Lessons to mitigate future pandemics

Authors: C. Castillo-Chavez, R. Curtiss, P. Daszak, S. Levin, O. Patterson, C. Perrings, G. Poste, and S. Towers.

In brief*:* In this commentary, authors reflect on the consequences of outbreaks from zoonotic pathogens, like Ebola hemorrhagic fever, and consider what mitigation strategies to deal with risks of future pandemic threats from emerging diseases might look like. By combining targeted programs for behavior change at high-risk animal-human transmission interfaces, development investments that mitigate potential risks of commercial and livelihood activities that may drive disease emergence, and public health investments into vaccine development and outbreak preparedness and response training, there is great potential for improvements in mitigation at the source of a spillover event or outbreak. Further, future strategies must also be scaleable to mitigate pandemic risk for the global community by engaging diverse sectors and domains with a stake in reducing liability and improving risk assessment through collective investments in public health infrastructure, One Health platforms, improved predictive models of emergence, and surveillance and capacity strengthening programs like USAID's

PREDICT project. While it may be challenging to orchestrate such a suite of strategies globally, pandemics require concerted effort as the costs on our communities and economies when they strike can be devastating.

Citation: Castillo-Chavez C., R. Curtiss, P. Daszak, S. Levin, O. Patterson, C. Perrings, G. Poste, S. Towers. 2015. Beyond Ebola: Lessons for mitigating pandemics. *The Lancet Global Health* 3(7): e354-e355. Available online: http://www.sciencedirect.com/science/article/pii/S2214109X15000686

Envisioning a world without emerging disease outbreaks

Authors: C. Machalaba and W.B. Karesh.

In Brief: Recent outbreaks of emerging infectious diseases (EIDs) have seemingly appeared without warning and have resulted in resource-intensive responses. With our current public health systems largely emphasizing reactive approaches without a lens to ecological links and anthropogenic pressures causing their appearance, new approaches are urgently needed. In the short-term, systems can look toward strengthening capacity for surveillance of infectious disease in human populations, including more rapid and precise detection of cases, effective reporting channels, and collection of samples to document pathogen evolution and guide vaccine or other potential therapeutic development to yield greater infrastructure for early detection of and efficient response to outbreaks. As a long-term goal, public health systems can include paired human-wildlife surveillance and utilize sentinel monitoring toward pre-emption of spillover in humans. While these approaches will require upfront investments, cost-savings can be seen from more integrated and more preventive approaches that can benefit both human and animal health. To support these operational advancements, governance structures are needed that enable a One Health approach that proactively considers connections between human, animal, and environmental health across disciplines.

Citation: Machalaba, C. and W.B. Karesh. 2015. Envisioning a world without emerging disease outbreaks. *Solutions* 6(2): 63-71. Available online: http://www.thesolutionsjournal.com/node/237327

One Health approach to use of veterinary pharmaceuticals

Authors: A. Margalida, G. Bogliani, C.G.R. Bowden, J.A. Donazar, F. Genero, M. Gilbert, W.B. Karesh, J. Lubroth, X. Manteca, V. Naidoo, A. Neimanis, J.A. Sanchez-Zapata, M.A. Taggart, J. Vaarten, L. Yon, T. Kuiken, and R.E. Green.

In Brief: The thousands of tons of veterinary pharmaceuticals produced each year undergo minimal screening for their potential environmental impacts, including contamination threats to non-target species (including humans). Weak environmental assessment was demonstrated in the licensing of the non-steroidal anti-inflammatory drug diclofenac for veterinary use in Spain, despite its link to severe *Gyps* vulture declines in Southeast Asia - and subsequent bans on its use - nearly a decade earlier. As vultures provide critical ecosystem services in their removal of livestock carcasses,

Spain's regulatory decision raised concerns about wider implications for economies, ecosystems, and food safety. While placing a lens on veterinary pharmaceuticals, the paper calls for stronger overall environmental stewardship, highlighting the broader benefits of a One Health approach.

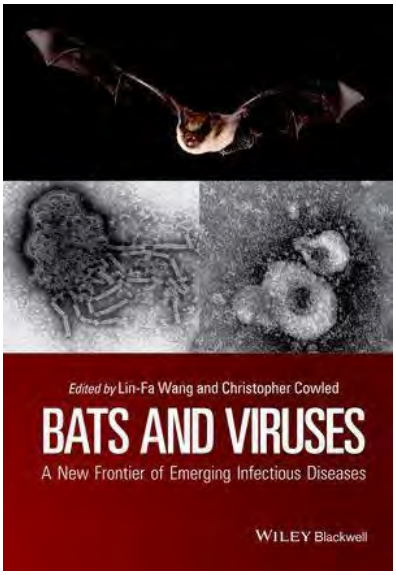
Citation: Margalida, A., G. Bogliani, C.G.R. Bowden, J.A. Donazar, F. Genero, M. Gilbert, W.B. Karesh, J. Lubroth, X. Manteca, V. Naidoo, A. Neimanis, J.A. Sanchez-Zapata, M.A. Taggart, J. Vaarten, L. Yon, T. Kuiken, R.E. Green. 2014. One Health approach to use of veterinary pharmaceuticals. *Science* 346(6215): 1296-1298. Available online: https://www.sciencemag.org/content/346/6215/1296.summary

BOOK CHAPTER

Are bats really 'special' as viral reservoirs: What we know and need to know

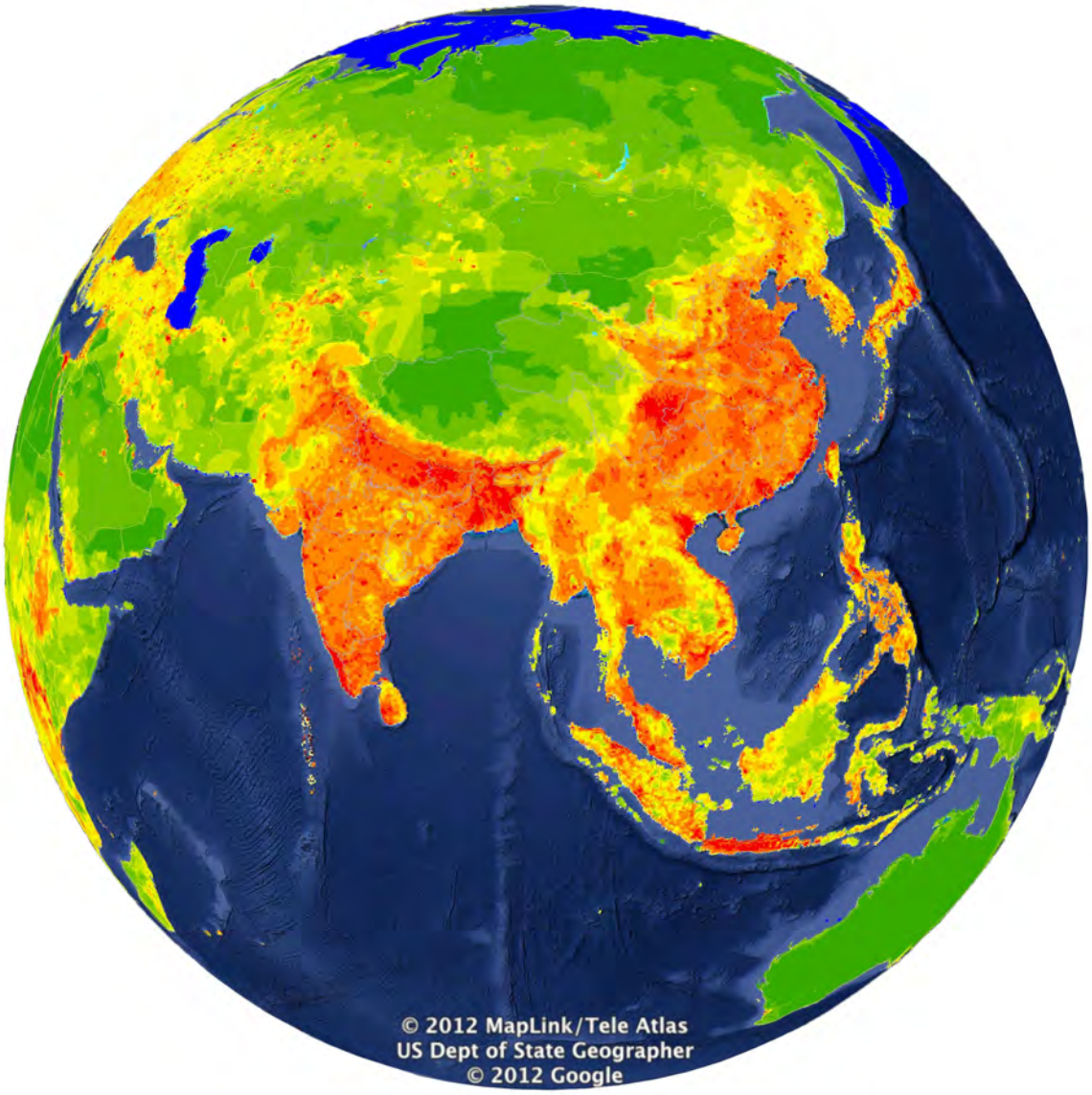
Authors: K.J. Olival, C.C. Weekely, and P. Daszak.

In brief: Bats (Order Chiroptera) account for almost a quarter of mammal species in the world and harbor a high proportion of zoonotic viruses. This chapter reviews the recent literature and provides further data analyses exploring whether bats are "special" in their ability to act as hosts for novel and known zoonotic viruses. Ultimately, the scientific literature does not give a clear indication of whether or not bats are "special." Our review suggests that there are major research gaps to be addressed both for bats as well as other mammalian taxonomic groups, and while bats may not be unique in their relationship with viruses, they should continue to be the focus of viral research and discovery.



Citation: Olival, K.J., C.C. Weekely, P. Daszak. 2015. Are bats really 'special' as viral reservoirs: What we know and need to know. In Wang, L.F. and C. Cowled (Eds.), *Bat Viruses: A New Frontier of Emerging Infectious Diseases* (281-294). New Jersey: Wiley-Blackwell.

VI. FEATURED PRODUCTS



SECTION 6. PREDICT FEATURED PRODUCTS

6.1 SURVEILLANCE – HUMAN SUBJECTS RESEARCH PROTOCOL, QUESTIONNAIRE, AND HOSPITAL INTAKE FORM

PREDICT's surveillance for emerging pathogens focuses on areas of the world at the highest risk for zoonotic disease emergence. The goal is to move countries away from a reactive post-outbreak response to a proactive approach in which pathogens of pandemic potential are discovered at their source before large-scale epidemics occur in people.

PREDICT's disease surveillance strategy is based on the inextricable link between animals, humans, and the environment. Rather than prescribing an across-the-board surveillance plan, PREDICT works in each focus country to cultivate targeted, measurable, adaptive, and responsive approaches that are integrated across health and environmental sectors.

This year, PREDICT expanded in scope to target biological surveillance of wildlife and people in all areas of engagement to better understand the factors associated with viral spillover, evolution, amplification, and spread. To operationalize human subjects research for biological sample collection in health clinics and hospitals in all focus countries and to ensure that data collected captures behavioral factors that may play a role in disease transmission, PREDICT leveraged consortium expertise to develop a Master Protocol to guide human surveillance activities in all countries and to ensure compliance among all sites engaged in human subjects research at global and local levels. In addition, consortium partners collaborated to develop a Human Questionnaire and Hospital Intake Form (included below) that are now being translated into local languages by country teams. These materials were submitted to the UC Davis Institutional Review Board (IRB) for approval, which the team anticipates receiving in January 2016.

1) **Protocol Title:** PREDICT - Surveillance for emerging zoonotic disease threats and behavioral risk characterization in high-risk communities in Asia and Africa

   Protocol Date: September 1, 2015, revised December 22, 2015

2) Author of Protocol

X UC Davis Researcher
X Researcher from other institution

3) IRB Review History

The PREDICT research team submits this new protocol as a Master Protocol designed to describe all research activities involving human subjects research in participating countries. PREDICT is a collaborative disease surveillance and capacity strengthening program funded through the USAID Emerging Pandemic Threats program. The geographic scope of program activities, including those involving human subjects is dynamic and subject to change. Currently, PREDICT is active in 17 countries in Africa and South and Southeast Asia: Bangladesh, Cambodia, Cameroon, China, Democratic Republic of Congo (DRC), Gabon, Indonesia, Lao PDR, Malaysia, Myanmar, Nepal, Republic of Congo (RoC), Rwanda, Tanzania, Thailand, Uganda, and Viet Nam. PREDICT is expanding in scope with activities planned in Cote d'Ivoire, Egypt, Ethiopia, Ghana, Guinea, India, Jordan, Kenya, Liberia, Mongolia, Philippines, Senegal, Sierra Leone, South Sudan, and Sudan. *A more extensive description of the study sites in the countries currently participating in the PREDICT project is included under #23 "Setting" below.*

PREDICT will seek approval for research activities involving human subjects from all participating countries through Institutional Review Boards, ethical clearance councils/committees, and national research administrations following local regulatory guidelines as appropriate. Separate IRB protocols for each country and any amendments to locally approved research protocols or consent forms diverting from Master Protocol activities will be submitted to the UC Davis IRB Administration for review.

4) Objectives

This research aims to 1) detect and characterize new and known viruses of epidemic and pandemic potential in high-risk communities and patients admitted to hospitals; 2) identify biological, behavioral, and ecological factors influencing the risk of viral spillover, amplification, and spread; and 3) determine potential targets for intervention based on high-risk human behaviors and practices that amplify disease transmission in hotspots for viral evolution, spillover, amplification, and spread.

Surveillance of high-risk human populations, the focus of this protocol, is part of the larger PREDICT project. In addition to the objectives stated above, PREDICT aims to conduct concurrent surveillance in animals that is temporally and spatially aligned with sampling of people in high-risk communities. Our overall goal is to identify animal reservoirs and amplification hosts for zoonotic viruses, strengthen human and animal disease surveillance system capacities in hotspot regions, and establish collaborative One Health platforms to reduce the risk of disease spillover, amplification, and spread.

The PREDICT project is led by a Consortium of organizations in the US based at the University of California, Davis. Consortium members include: UC Davis (UCD), EcoHealth Alliance (EHA), Metabiota, Inc. (MB), Smithsonian Institution (SI), and Wildlife Conservation Society (WCS). Activities in each of the PREDICT countries are implemented by local partners in collaboration with one or more of the PREDICT Consortium partners under the guidance of operational teams, the PREDICT Executive Board, and a Senior Management Team with representation from USAID. Appendix A provides a list of current PREDICT partners by country.

US-based Consortium personnel will provide support for study design and planning, and technical and analytical support during implementation, along with assuring compliance in countries where each partner is lead (see Appendix A for a full list). All research procedures will be conducted by local implementing partners in accordance with local laws and IRB regulations (and/or other relevant governing authority regulations for human ethics as appropriate).

IRB authorization agreements establishing UC Davis as the Reviewing IRB of Record have been established with EcoHealth Alliance and Metabiota, Inc. Documentation for each authorization agreement has been provided in the appendices. Authorization agreements to establish UC Davis as the Review IRB of Record are currently in development with the Wildlife Conservation Society and Smithsonian Institution.

The research will be conducted only after obtaining ethical approval from local institutional review boards at the country-level.

5) Background

Emerging infectious diseases (EIDs) pose substantial threats to the health of animals, people and economies globally (Smolinski et al. 2003; Daszak et al. 2004). Zoonotic pathogens shared with wild or domestic animals account for the majority of EIDs, and viruses comprise 25-44% of these emerging and re-emerging pathogens (Jones et al. 2008; Taylor et al. 2001). Over the past decade, attempts to control deadly zoonotic viruses, like Severe Acute Respiratory Syndrome (SARS) and Middle Eastern Respiratory Syndrome (MERS) coronaviruses and highly pathogenic avian influenza viruses, have been, out of necessity, almost entirely reactionary. Due in large part to USAID's Pandemic Influenza and Other Emerging Threats Program, the world is poised to move beyond this costly approach, which measures impact in death tolls and money spent on diagnosis, treatment and containment. PREDICT is predicated on a proactive

paradigm that facilitates the applied use of a growing body of knowledge in which emergent diseases may be identified at their source and intervention strategies developed to prevent spillover or at least control zoonotic pathogens at the source and prevent further disease spread.

As stated above, the PREDICT Consortium is led by a team based at the University of California, Davis. From 2009-2014, the Consortium developed and stewarded the first phase of the PREDICT project in Africa (Cameroon, Gabon, RoC, DRC, Tanzania, Uganda, and Rwanda), Asia and SE Asia (Bangladesh, Cambodia, China, Indonesia, Lao PDR, Malaysia, Nepal, Thailand, Vietnam), and Latin America (Bolivia, Brazil, Mexico and Peru).

Working closely with government ministries, scientific institutions, local organizations, and other stakeholders, the Consortium significantly advanced One Health capacity and infrastructure in these countries. By developing mechanisms for overcoming geographic and disciplinary constraints to public health protection, the Consortium established multidisciplinary collaborations and systems for data sharing across Ministries. High-risk human-wildlife interfaces were selected for investigation of viral spillover from wildlife hosts to humans and their food animals. Human and animal samples were screened for viral families suspected to be sources for new potential zoonotic pathogens impacting people, using consensus PCR and complemented with high-throughput sequencing as needed. In this first phase of the PREDICT project, the Consortium detected more than 100 known viruses and 800 new viruses with the goal to examine these data in the context of human-wildlife contact to assess risk and inform mitigation strategies.

Building on the surveillance activities to date, the Consortium is focusing surveillance in locations where environments and market systems are changing in ways that are conducive to the spillover of viruses from animals to people. Despite greater recognition of emerging zoonoses, the exact mechanisms of viral spillover and transmission from animals to humans are poorly understood (Murray and Daszak 2013). This proposed research aims to provide a better understanding of the drivers and host-pathogen dynamics, including which human behaviors and practices increase risk, and under what circumstances these behaviors facilitate spillover of zoonotic viruses.

This research will also contribute to a better understanding of undiagnosed illnesses experienced by people with exposure to animals. Because the surveillance will be conducted in both community and hospital settings, this research will address limitations in community-based studies for which detecting virus and viral spillover would be near impossible, as well as limitations in hospital-based studies in which patients seeking care might not be representative of people with high-risk animal interactions.

6) Inclusion and Exclusion Criteria

Research subjects to be enrolled in this study will be those living, working, or visiting the locations selected by PREDICT at priority surveillance sites who meet the inclusion criteria outlined below. PREDICT study sites are prioritized according to ecological and

epidemiological conditions associated with a high risk for zoonotic disease emergence (i.e. close contact between humans and taxonomic animal groups from which zoonotic viruses have emerged previously).

Research subjects will be enrolled in two settings:

1) People living in, working in, or visiting targeted high-risk communities who have close contact with wildlife and livestock. In high-risk communities, we anticipate interviewing and collecting biological samples from individuals with a range of exposure to animals. Recruitment will also take into account any known or observed differences in animal contact or practices associated with racial/ethnic minority, religious or immigrant status. Enrolled research subjects will provide biological samples and complete a questionnaire that is designed to obtain demographic information, as well as medical history and quantitative data on behavioral interactions with animals. A subset of people in high-risk communities will complete the questionnaire only, and will not provide biological samples, to increase the sample size and broaden the scope of behavioral data collected from these communities.

2) Patients at clinics or hospitals presenting with disease symptoms of unknown origin. In particular, we will target patients that have already tested negative for normative disease screening (e.g., influenza) when routine and reliable diagnostic testing is being done by collaborating clinics and hospitals, so that we can enroll patients with undiagnosed causes of diseases, such as severe acute respiratory disease[1], encephalitis of unknown origin and hemorrhagic fevers. As with the community-based group, biological samples will be collected from the patients, and the patients or his/her designate will complete a questionnaire.

Additional inclusion criteria:

1. Adults (18 years of age or greater) who provide informed consent
2. Children (2 -17 years of age)* with an accompanying parent or guardian who is able to provide informed consent, with assent of children 12 years or older also required
3. Pregnant women will be considered eligible
   **Children defined as 2-17 years unless the age of majority in a participating country differs. In these cases, the age range for children will be listed in the country specific IRB protocols.*

[1] WHO SARI case definition: history of fever or measured temperature greater than or equal 38 degrees centigrade, and cough with onset within the last 10 days, and requires hospitalization.

Exclusion criteria:

1. Individuals over the age of 2 years who refuse to provide informed consent
2. Adults unable to provide informed consent, including individuals with physiologically or medically induced cognitive impairments
3. Children without an accompanying parent or guardian who is able to provide informed consent, or a child 12 years or older unable or unwilling to provide assent
4. Children < 2 years of age
5. Prisoners

7) Number of Subjects

This is a multicenter study, and we estimate approximately 4,860 individuals will be enrolled per participating country over the course of the project. This estimate is the target sample size following consent and screening procedures (excluding screen failures). Estimated sample size is based on a sample of 180 individuals per high-risk community, sampled for 2 seasons for 3 years, with replication at 3 high-risk communities (n = 3,240) and a sample of 180 individuals at 3 clinic/hospital sites per country for 3 years (n = 1,620). In addition, only the questionnaire (no biological sampling) will be administered to approximately 1,000 additional human subjects in each country where a particularly high-risk site is identified through on-going work.

Country-specific protocols will be amended to this Master Protocol, and estimated sample size may vary by country according to the number of study sites..

8) Recruitment Methods

In order to recruit individuals within target communities, introductory visits will be made by country project staff to each of the participating sites. These visits will be advertised through word of mouth. During site visits, discussions and meetings will be held to educate, sensitize, and inform people about zoonotic pathogens and potential pathways for disease spread/emergence. These discussions are already conducted in study communities as part of ongoing disease surveillance activities of animal populations. When appropriate and following approval from local authorities, the study team will work with key informants in the community to organize a “town hall meeting” to speak about enrollment. This “town hall” meeting will be completely voluntary, and, based on our experience, those interested would likely attend. Although local authorities may be present to introduce the study team members, they will not be involved in the recruitment and/or consent of the participants for the study. If research visits or recruitment will be held at a workplace, the study team will work with employers to obtain permissions to conduct the study during times that do not disrupt work. Subjects will be clearly informed during the recruitment process that their participation in the study is voluntary and will not impact their employment, that measures will be taken to ensure privacy in participation, and that no information discussed will be shared with employers. Every effort will be made to ensure participation is voluntary and confidential.

An introduction script will be used to inform individuals of proposed project activities (see Appendix B: PREDICT Informed Consent Form). The language will be geared to a 5th grade level in the local language, to ensure that potential community participants understand the study purpose and eligibility inclusion guidelines.

Participation in the study will be strictly voluntary and will require signed, informed consent (Appendix B: PREDICT Informed Consent Form). Participants will be given a consent form prior to being asked to participate in this study. They will review the consent form with the research staff and will be given time to ask questions. After reviewing the consent form, study staff will explain details of the study including: why they were selected, potential risks due to their participation, how their participation is beneficial, that their participation is completely voluntary, and that they can withdraw their participation at any time. Responses will be kept strictly confidential. Measures will be taken to assure the respect, dignity and freedom of each participant. During training of research staff, we will emphasize the importance of avoiding coercion and protecting the privacy of participants.

Community-based recruitment: For the community-based research, cluster sampling will be performed where concurrent sampling of animals is being conducted at high-risk disease transmission interfaces. Cluster sampling is used when constructing a frame of the observation units may be difficult, expensive, or impossible. For example, it may be difficult to determine the total number (denominator) of hunters in a province or district, making it impossible to select a random sample. If the cluster is small enough, the entire cluster of individuals may be recruited for enrollment. However, if the cluster is large (~50 individuals), only a subset from the cluster will be recruited.

In order to obtain a subset of respondents from large clusters of over 50 individuals, research staff will use systematic random sampling, which is a relatively simple method to apply in the field and is the most commonly used method in two-stage cluster sampling. Systematic random sampling is implemented by selecting a random starting point to initiate the questionnaire and sample collection. After the questionnaire and sampling are complete, the research staff will move X units (e.g. market stalls, dwellings, beds in group housing) and select the Xth unit for study participation. For example, in a large wildlife market, the first vendor would be selected at random for study participation. Upon completion of the study requirements, study staff would then move 3 stalls down (if X=3 for desired sample size) and select an individual at the stall on the right for study participation, and so on. Only one person per unit (e.g., household, market stall) will be recruited for study participation.

Clinic and hospital-based recruitment: Patients for enrollment will be identified in the intake area, the emergency room, in the ward, or in the intensive care unit of each participating clinic and hospital by clinic staff according to standard operating procedures at collaborating sites. Employed staff at each location will identify potential participants that fit undiagnosed viral syndromes in patients. Patients will be screened for eligibility according to the inclusion/exclusion criteria based on available clinical information only.

In general, patients will be enrolled using a quota system until approximately 20% of the participants are children < 18 years of age and 80% are adult. For larger hospitals and clinics, interval sampling will be implemented by selecting every Nth case at the site among those individuals who meet enrollment criteria. The interval will be determined by local implementing partners based on an evaluation of the expected number of cases presenting at the site within a given year in order to best meet study design and sample size criteria. For example, in a large hospital with many patients meeting enrollment criteria, the first patient meeting criteria would be selected for study participation followed by selection of every 3rd or 5th individual (depending on the appropriate interval) until the maximum sample size has been obtained.

9) Compensation to the Subjects

Upon completion of study procedures, participants may be provided with a 'gift' or token of appreciation for their time, expertise and participation. Gifts will be valued at no more than 10 USD, and gift items and amounts will be determined by local PREDICT research teams to ensure cultural relevancy and consistency with regulations and research practice. Typically gifts include something like a soda, rice, cooking oil, laundry detergent, or soap, and may include cash.

10) Study Timelines

Patients/participants will volunteer approximately 1 hour of their time for participation in the study including providing biological samples and completing the questionnaire.

The PREDICT project is an ongoing, five year project (end date of September 30, 2019). If funding is available, we may extend the project for another five years (samples/data will be maintained for a maximum of ten years). Completion of preliminary analyses is expected in 2019.

11) Study Endpoints

The primary study endpoints are 1) detection of new and known viruses shared with animals at high-risk human-animal interfaces, and 2) identification of human behaviors and practices facilitating the risk of viral spillover and potential targets for intervention.

Secondary endpoints are to report study findings to communities and medical personnel and to build awareness for zoonotic disease transmission in high-risk communities.

12) Procedures Involved

STUDY DESIGN

All field research procedures including biological sampling and interviews will be conducted by local individuals trained by PREDICT staff listed on this protocol and using PREDICT data collection protocols and training materials. As stated above under

"Objectives", US-based personnel will be minimally involved in the sampling or management of human subject research material or identifiable data. In rare cases where US-based personnel are supporting country teams with specimen collection, interviews, or data management, these personnel will be listed in the country-specific IRB protocols submitted to UC Davis and in the host country IRB protocols to ensure full coverage. US-based PREDICT personnel and Country Coordinators (or their designated project coordinator for human subject research activities) at each site will be required to complete CITI training, as well as all PREDICT training modules, prior to initiation of activities.

Surveillance and behavioral risk characterization will involve individuals from both community-based and hospital settings from PREDICT priority surveillance sites with high-risk for viral spillover, evolution, amplification, and spread. All study participants will be administered a questionnaire (Appendix C – PREDICT Human Questionnaire) that assesses work practices, mobility, illness experiences, and exposure to animals. Hospitalized participants will also be given a specific questionnaire (Appendix D – PREDICT Hospital Intake Form) that targets their symptoms, as well as their work practices and potential exposures to animals.

1) Individuals living, working, or visiting targeted high-risk communities who have close contact with wildlife or livestock:

Individuals living with or near animals in sites that have been identified as concurrent sampling sites for animals and humans will be asked to provide biological specimens, as well as to complete the questionnaire at the time of specimen collection. The primary goals of this study are to find evidence for zoonotic viral sharing between animals and humans and to examine the high-risk human behaviors and practices that amplify disease transmission, spillover, amplification and spread.

Questionnaires (Appendix C – PREDICT Human Questionnaire) will be administered to all individuals providing biological samples, as well as to additional subjects in high-risk communities who will not provide biological samples. The questionnaire-only participant data is being collected to provide larger sample sizes for analysis and to build and test models of human practices that may be associated with high risk for zoonotic disease exposure. Subjects to receive only the questionnaire will be selected from communities where concurrent sampling of animals is being conducted, following the cluster sampling procedure described above.

2) Hospital and clinic patients with undiagnosed infectious diseases:

Patients who satisfy inclusion and recruitment criteria as described above will complete the questionnaire (either Appendix C – PREDICT Human Questionnaire or Appendix D – Hospital Intake Form, as appropriate given the clinical setting) and provide clinically relevant biological specimens to be tested using PREDICT protocols. When feasible, admitted hospitalized patients will have 2 blood samples collected, one on the day of enrollment and one taken seven days after enrollment or

before discharge in accordance with standard of care, but will only be administered the questionnaire once upon enrollment.

Biological sample collection:

Duplicate samples will be collected from each research subject by trained staff of in-country implementing partners. These will include:

1. Oral swab
2. Nasal swab
3. Whole blood
4. Serum
5. Other samples that could be collected include oropharyngeal, nasopharyngeal swab, urine, rectal swab, and/or feces in clinical settings as appropriate.
6. For clinic and hospitalized patients, if urogenital swabs, cerebral spinal fluid (CSF), pericardial fluid, pleural fluid, ocular swabs, or other samples have been collected by medical staff for diagnostic purposes, PREDICT testing will be conducted on remaining sample aliquots after standard diagnostic procedures have been completed.

Trained staff will collect oral and nasal swab samples from subjects by gently rubbing a sterile, synthetic swab on the patient's nasal and oral mucosa for 2-5 seconds. For fecal and urine samples, the subject will be provided containers labeled with their ID in which to collect the respective samples and instructions on how to collect uncontaminated samples. Phlebotomists, doctors, or nurses will collect venous blood samples by standard venipuncture from the right or left antebrachium. Blood will be collected into a minimum of 1 vacutainer tube containing EDTA and serum separator tubes for a maximum of 12mL collected per individual (12mL for adults and children aged $\geq$13 years and 6 mL for children aged <12 years). When appropriate in clinical settings, staff will collect nasopharyngeal, oropharyngeal, urogenital, and rectal swabs. Rectal swabs will be collected by gently inserting sterile, flexible, nylon-tipped swabs into the anal canal and moving them from side to side and rotating while removing. Urogenital swabs, CSF, pericardial fluid, and pleural fluid samples will be collected by medically trained personnel in the clinical setting as part of necessary diagnostic procedures with aliquots made available for additional testing using PREDICT protocols when material is available after the required procedure.

For swabs, whole blood, feces, and urine samples, one sample will be collected into Trizol and another in viral transport media (VTM). If only one sample can be collected, it will be collected into VTM. Other fluids, such as CSF, pericardial fluid, serum, and pleural fluid will be collected into vials without Trizol or VTM as appropriate for the primary diagnostic procedure. If these clinically relevant samples are collected from patients, an aliquot may be frozen without Trizol or VTM for later processing. Samples will be frozen in an ultralow (-80°C) freezer for storage until analysis. In the field, samples will be frozen immediately in liquid nitrogen and then transferred to an ultralow (-80°C) freezer for storage until analysis.

Laboratory analysis:

Viral detection and discovery:
Virus detection in human samples will be performed using a combination of consensus PCR (cPCR) and high throughput sequencing (HTS) to detect known and discover novel viruses from different sample types. Viral families/genera targeted are of potential pandemic or epidemic significance, as well as those with previous association with ILI, SARI, FUO, and hemorrhagic disease and may include corona-, paramyxo-, influenza, retro-, arena-, filo-, flavi-, bunya-, reo-, rhabdo-, picorna-, and alpha-viruses. Some viruses will be further characterized using tools, such as full genome sequencing and virus isolation to understand more about viral genetic and phenotypic traits.

Serology to characterize exposure in human and animal populations and detect spillover:
Once new viruses are detected and are prioritized for further characterization we will, on a selective basis, develop serological assays to screen populations of people and animals (both livestock and wildlife) at high-risk interfaces to determine whether pathogen sharing has occurred. Serology may be used to characterize the frequency of host jumping within specific amplification zones, such as on farms and in markets, by screening animal and human populations that are in close contact at high density. When appropriate, serological assays for known agents, such as influenza A, MERS Coronavirus, SARS-like Coronavirus and Ebola virus, will also be used.

Molecular detection of bacterial pathogens:
Consensus or cPCR targeting conserved genes (e.g. 16s) will be used when appropriate to identify the full range of bacterial pathogens and to identify new bacterial agents in specimens from patients with diseases of unknown origin (DUO) where the viral infections have been ruled out.

DATA ANALYSIS

Analysis of questionnaire data will involve calculation of metrics of contact for each risk group under study, such as the proportion of respondents indicating they have butchered live animals, seen wildlife in their homes, been bitten or scratched by animals, etc. Comparisons of metrics of contact between men and women, children and adults as well as different study communities will be conducted in order to explore the environmental and social factors (gender, age, occupation/religion, socioeconomic status (SES)) that influence contact with animals and to determine who is most at risk. Statistics will be computed to identify differences between groups that are significant at $P \leq 0.05$. Various metrics of contact related to different activities within specific groups will be compared to determine the activities that put groups at most risk. Finally, multivariate analysis as appropriate for the outcome measure (e.g. ordinary linear regression, logistic regression, generalized estimating equations that correct for cluster effects and non-normal distributions of outcome, etc.) will be employed to explore the relationship between key metrics of contact and the factors that influence frequency and types of human-animal contact.

Test results and viral sequences obtained from human and animal (wildlife and livestock) samples will be compared and phylogenetic analysis performed to document viral sharing between animals and humans. The test results data will be analyzed in the context of the questionnaire data to identify high-risk human-animal interactions and behaviors or practices that are associated with viral spillover and/or sharing. Specifically, we will calculate odds ratios for demographic and behavioral risk factors associated with the outcomes of viral infection or exposure among communities sampled. Self-report of medical history and illnesses collected through the questionnaires will also be evaluated for associations with demographic and behavioral risk factors. Regression analyses will allow for statistical assessment of both categorical and continuous predictor variables and hierarchical aggregation of data to adjust for correlated factors within communities. Data on self-reporting of illnesses will be triangulated with biological data from the concurrent animal and human sampling to identify symptoms and illnesses that could be correlated with potential pathogens.

Surveillance and behavioral risk findings will be used to identify potential targets for intervention and to inform policy development in collaboration with national authorities in public and animal health. Ultimately, data from viral surveillance and behavioral risk characterization will be integrated with broader economic, anthropologic, and ecological data in an analytical framework to identify risks and trends in disease emergence globally.

13) Data Management and Confidentiality

DATA/SPECIMEN MANAGEMENT PLAN (see also Data Analysis section immediately above)

All research procedures will be conducted by local implementing partners in accordance with local laws and IRB regulations (and/or other relevant governing authority regulations for human ethics as appropriate). Only local partners will have access to identifiable human subjects data. In rare cases where US-based personnel are involved in project implementation, these personnel will be listed in all country-specific IRB protocols to ensure coverage at the local level.

All questionnaire data (including hospital intake form data) and biological samples will be labeled with a unique alphanumeric identification code, assigned to each enrolled, sampled individual that does not identify the individual from whom data are collected. No personal identifying information will be recorded on the sample vials or on the questionnaires.

For community level sampling, biological samples will be stored in locked liquid nitrogen dry shippers following collection in the field and during transport to PREDICT partner diagnostic laboratories. Transport of the samples to the laboratory from the field will be performed by PREDICT in-country personnel.

In the clinics and hospitals, samples will be stored in locked liquid nitrogen vacuum flasks, dewars, or in a locked -80C freezer. Samples will be transported to PREDICT partner diagnostic laboratories by PREDICT personnel in locked liquid nitrogen dry shippers or shipped through approved couriers in dry shippers or in approved secured containers with dry ice.

When shipping samples, the shipper will notify the laboratory on the day of shipment and provide the air bill/tracking number(s) and itemized shipping log. The shipping log will not contain any personal identifying information. Samples will be stored in a locked -80C freezer at the local PREDICT partner diagnostic laboratories or institutes. Only trained clinic and hospital staff and PREDICT personnel will have access to the specimens. Subject privacy and confidentiality practices will be addressed during training of all study personnel.

Safety precautions: PREDICT has standardized protocols and training to ensure the safety of staff involved in research activities, including biological specimen collection. Specimens will be collected by trained clinic staff wearing appropriate PPE, including gloves, fitted and tested N95 masks, gowns, and closed toed shoes. When samples are shipped between countries, they will be packed frozen into dry shippers designed for shipment and approved by the International Air Transport Association (IATA). Any specimens transported by air to regional or reference laboratories as part of continuing PREDICT laboratory network collaboration among established partners will follow safety and IATA guidelines provided to staff. US CDC permits are in place to allow for importation of biological specimens and infectious substances, under which shipping of samples must also comply with the Safe Sample Transport guidelines.

All PREDICT project personnel handling specimens and involved in their transport are trained annually with documentation of training maintained by the PREDICT through our internal database, the Emerging Infectious Disease Information and Technology Hub (EIDITH). Training oversight at each location is provided by the PREDICT Country Coordinator and supported by regional leads under the supervision of the PI.

Data quality control: All data are examined at entry and later upon integration into the study database, for completeness, accuracy, and logical consistency. Once all test results (e.g. initial detection by PCR, subsequent sequencing of viruses, and serology) are available for a given specimen, the results are interpreted in light of all available scientific literature and previous PREDICT findings by team scientists.

Data identification: Data will be identified by a unique identification code assigned to each sampled individual. Participants' names and codes will be recorded in the confidential participant logbook, which is completed in the field by field staff and retained by the PREDICT Country Coordinator. All records that contain names or other personal identifiers, such as informed consent forms and the confidential participant logbook, will be stored separately from study records. All personal information will be stored securely at the country headquarters in locked files cabinets in areas with access limited to study staff. Consortium partner representatives that are not listed in locally

approved protocols, including UC Davis personnel, and global consortium partners will have access only to coded data that cannot be linked to identifiable information.

Protection during data transport: All data collected on paper forms will be transported from the study site to the local collaborating laboratory or collaborating institute in locked containers. Password-protected laptops or tablets will be used to collect coded data only. Personal identifying information will not be stored in electronic form. Only PREDICT project laptops or tablets will be used for data collection (i.e. no personal computers or tablets will be used). All data transmitted electronically will be 128-bit encrypted. Email will not be used to transmit personal identifiable data. PREDICT laptops and tablets are inventoried by each local research team and all coded electronic data will be backed-up to secure servers maintained by a secure, 128-bit encrypted and password-protected centralized database. If offline, coded tablet data will be backed-up to secured password protected laptops connected to the centralized database or to micro-SD cards for uploading to project laptops at frequent intervals. In the case of theft, tablets are equipped with remote wipe capability to allow devices and all coded data to be erased remotely; project laptops are secured in all facilities with locks and theft prevention devices.

Data storage: PREDICT specimens will be banked in each country in dedicated collaborating partner facilities and locked ultralow laboratory freezers. Access will be restricted to trained personnel. PREDICT will utilize a secure, 128-bit encrypted and password-protected centralized database to store data for access by the PREDICT consortium only for surveillance data analysis. The database is maintained by the PREDICT information management team. There is no public access to the database.

POWER ANALYSIS

As stated previously, this is a multicenter study, and we estimate approximately 4,860 individuals will be enrolled per participating country over the course of the project. This estimate is the target sample size following consent and screening procedures (excluding screen failures). Country-specific protocols will be added and estimated sample size may vary by country. Estimated sample size is based on a sample of 180 individuals per high-risk community, sampled for 2 seasons for 3 years, with replication at 3 high-risk communities (n = 3,240) and a sample of 180 individuals at 3 clinic/hospital sites per country for 3 years (n = 1,620). This estimated sample size will allow for 80% power to detect a third-fold difference in risk with 95% confidence, assuming 1.2% prevalence in viral detection using the PREDICT PCR protocols for virus detection and adjusting for 0.2 correlation in data. Pilot data from similar studies conducted in high-risk communities during the first phase of PREDICT have indicated a 0.8-1.5% prevalence should be expected for virus detection using PREDICT protocols targeting priority viral families. In addition, the questionnaire only will be administered to approximately 1000 additional human subjects in each country.

14) Data and/or Specimen Banking

Data and specimens will be securely stored for up to ten years as described above with personal identifying information kept in a secure manner. This study could be extended by five-year increments in perpetuity (currently in the second phase of 10-year project). Upon completion of the project personal identifying information will be destroyed unless this protocol is extended or amended for a maximum of ten years of sample and data storage.

HIPAA Standards in International Research:

U.S. federal laws do not apply to studies conducted overseas or in foreign countries. However, human subject standards of protecting confidentiality and privacy for research still apply and will be instituted across PREDICT sites during this project phase and in all subsequent phases. International research subjects do not need to sign an authorization to allow access to their protected health information (PHI).

15) Provisions to Monitor the Data to Ensure the Safety of Subjects

The data collected and the procedures performed are within the scope of good clinical practice and pose no more than minimal risk to the volunteer. Proposed activities are designed for integration into each participating country's emerging pandemic threats surveillance program and no more than minimal risk is anticipated.

Trained health professionals from local clinics/hospitals or otherwise appointed/approved by the country's Ministry of Health will perform all specimen collection. The personnel tasked with conducting this procedure will be well trained in PREDICT protocols and in Universal Precaution Practices to ensure safe sample collection, and to ensure that the sample collection process causes the least discomfort possible to the participant. In addition, they will supervise the administration of questionnaires or hospital intake forms as appropriate. These individuals will be trusted members of the community and will have often treated the participants or their family members before. Every effort will be made by PREDICT trained human data collectors to make sure the respondent is comfortable when answering sensitive questions. Participation in this study will not alter the medical evaluation or therapy provided to the participant by the clinical or medical officer and will be based on the standard of care at the treating facility.

As described above, no identifying information will be stored with or paired with questionnaire data or biological specimens. As the data samples will be coded within the database for the lifetime of the study and the on-site data log will be stored in a secure manner, the risk of a loss of confidentiality is minimized for the study volunteers. In the case of positive results for relevant viral families, a summary report with interpreted results will be provided to the health officials or lead physicians as appropriate, for consideration of potential pathogens to which their patient populations have been exposed. When questionnaires are moved to the country headquarters, records will only contain coded data to ensure the safety and confidentiality of participants and will be maintained in a secure database. The only document that will link the participant with a

unique ID number is the consent form, which will be stored in a locked file separately from participant data in the offices of the Country Coordinator.

At the completion of each surveillance period, generally on a calendar year schedule, a data and safety review will be conducted at each site with the clinical staff and the PREDICT country team. At this review, safety information and adverse effects collected during the performance period will be discussed and addressed. Data may include case report forms, notes from study visits, and or any telephone calls to the PI from participants. Adverse effects from PREDICT sampling protocols are expected to be exceedingly rare, but if any unusual conditions are observed by the clinic or clinical team, PREDICT will trigger a notification within 5 working days, to assure that additional data collection and investigations are initiated. As this study will integrate with each country's Ministry of Health emerging pandemic threats surveillance program, minimal risk is anticipated, but each in-country team will work together in the first year to establish criteria about what untoward event might constitute a condition for triggering immediate suspension of the work.

Report summaries of the data generated from the project will be provided to the Ministry of Health and to other in-country collaborating investigators, at their request. Adverse or serious adverse events included in report summaries to the Ministry of Health and other in-country collaborators will be reported to the UC Davis PI following procedures described in Section 20 "Multi-Site Research".

16) Withdrawal of Subjects

There are no anticipated circumstances under which subjects will be withdrawn from the research without their consent. If an individual decides to withdraw from the research study, their samples and data will be removed from analysis and destroyed.

17) Risks to Subjects

Collection of venous blood samples and oral, nasal, nasopharyngeal, and oropharyngeal swab samples pose minimal risk to subjects. Potential complications associated with venipuncture include pain and/or hematoma at the site of collection. Trained medical professionals and/or clinic staff will monitor the blood collection site and treat any complications according to existing health facility protocols. A potential complication of nasopharyngeal, oropharyngeal, and rectal swab sampling is minor irritation at the time of collection. Using trained medical and/or clinic staff to collect blood and swab samples will minimize the potential for complications. No physical risk is associated with subjects collecting their own fecal or urine samples. Clinic staff will give subjects specific instructions on safely collecting fecal and urine samples including appropriate guidelines for hand washing after sample collection. Any additional samples from hospitalized patients (e.g., cerebrospinal spinal fluid (CSF), sputum, pericardial fluid, pleural fluid, and ocular swab samples) will only be collected for routine diagnostic purposes by physicians or trained hospital staff; there is no additional risk to the patient from this study, as PREDICT will only be sourcing remaining sample aliquots for supplemental

testing. At the community level, biological sampling will be conducted in a safe private place to ensure that all individuals are treated in a respectful manner and that participation and privacy rights are upheld.

Potential risks associated with providing responses to questionnaires on wild animal contact and consumption could include consequences from local authorities if such practices are prohibited by local laws. To minimize this risk, questionnaire data will be collected in a strictly confidential manner. Individual interviews and biological sampling will be conducted in private, ensuring that others cannot hear the interviews. Individual sessions will be held in areas where there are no other individuals within a 10-foot distance. A barrier will be created so that no other individuals can view the participants while they are in their interview or being sampled. Depending on the location, this could be a private room, behind a building or fence, or behind a line of trees, obstructing view so that confidentiality may be maintained. The interview team will take care to pair interviewers and respondents by sex to ensure protection of women and children and privacy and confidentiality of responses. Children will not be interviewed in the absence of a parent or guardian. In addition, identifying information will not be linked to responses, and data will be stored in secure, password protected files or secured storage facilities.

Another risk that this study may pose concerns the information to be gained on zoonotic viruses newly recognized in the community. We will provide participating hospitals and clinicians with information and background data on target zoonotic viruses to ensure up to date communication of risk. Because of the timeline for diagnostic testing and results interpretation, we are not likely to provide results to participating clinics within a time frame that would be clinically relevant to outbreaks of undiagnosed diseases. Therefore information provided by this project will not impact patient management or outlook.

18) Potential Benefits to Subjects

There is no measureable benefit to the individual participant from taking part in this study. The PREDICT team will inform community participants of the aggregate findings and provide information about zoonotic infections and measures to reduce their risk of infection. One key benefit of this study to the community is to understand the risk of zoonotic infections among high-risk populations. This information may help us to detect and prevent potential epidemics involving emerging zoonotic agents, as well as to eventually counsel communities on practices that could reduce exposure and related health risks. These sentinel populations will be very important in providing cost-effective and timely information on disease emergence. The study will also increase understanding of the conditions and human activities associated with the introduction of zoonotic infections into human populations, which may have implications for disease control worldwide.

19) Vulnerable Populations

Pregnant women and children 2-17 years of age will be eligible to participate in the study if they meet the inclusion criteria provided in #6 above. As stated above, where the age of majority differs from this age range, an updated age range consistent with host country law will be detailed in the country-specific IRB protocols.

Collection of venous blood samples, nasal and oropharyngeal swabs, and fecal samples poses minimal risk to children and pregnant women and their fetuses. Children will only be enrolled in the study if accompanied by a parent or legal guardian and informed consent can be obtained from the parent or legal guardian. Assent will also be obtained from children 12 years and older. The child consenting process will be conducted on all participants aged 2-17, regardless of the age of majority in country.

20) Multi-Site Research

This is a multi-site research project, and activities will be implemented in participating PREDICT countries (see #3 above). Activities at the country-level will be approved by local ethical clearance councils and institutional review boards; such approval will be sought prior to implementation of any activities, and country-specific applications will be appended to this protocol. Modifications and approvals of protocols, as well as training on study protocols, ethics, and conduct of research activities for all participating personnel will be ensured and supervised by project PIs in coordination with the PREDICT Human Subjects Working Group. Communication among all sites, coordination of activities, training and sharing in best practices, and tracking of research activities will be conducted by the PREDICT Executive Board and PREDICT Operational Leads charged with Surveillance, Behavioral Risk, Pathogen Detection, Information Management, and Capacity Strengthening., Adherence to protocols will be tracked by PREDICT's Global Operations Officer at UC Davis.

Adverse events will be reported to the local study site ethical committee and to the UC Davis IRB administration. PREDICT field investigators will be working under direct supervision of the CITI-trained field coordinator who is responsible for reporting any adverse event in a timely manner to the CITI-trained country coordinator. The country coordinator will report the event to the local study site ethical committee and the PREDICT Project Principal Investigator and Operations Officer. The PI will then report the adverse event to the UC Davis IRB administration.

The country coordinator is responsible for ensuring that the following events are reported within the appropriate time frame: 72 hours in case of an adverse event and 24 hours in case of a serious adverse event. Adverse or serious adverse events will be reported by the field coordinator directly to the country coordinator who will then inform the local study site ethical committee or country IRB in writing within the following deadlines: 72 hours in case of an adverse event and 24 hours in case of a serious adverse event. The country coordinator will also report the adverse event to the PREDICT project PI and Operations Officer according to the same deadlines. The PI will report to the UC Davis IRB administration.

When communicating with the country sites, the PI will contact the country coordinator in each country site, who will then inform the field coordinator. In some cases, the country coordinator and the field coordinator will be the same person.

21) Community-Based Participatory Research

This protocol does not include community-based participatory research, though study objectives do target understanding risks and potential interventions to improve community health and some research activities do involve community cooperation. As stated previously, introductory visits will be made by country project staff to each of the participating sites to inform the community or hospital/clinic that a team will be coming to inform the community or hospital/clinic team of the research/surveillance visit(s). During these visits, discussions and meetings will be held to educate, sensitize, and inform people about zoonotic pathogens and potential pathways for disease spread/emergence (discussions and meetings may be held at hospital and clinic sites but only when determined to be appropriate in collaboration with site personnel).

In addition, voluntary “town hall” meetings may be held in participating communities to further dialog about study objectives and participation. Although local authorities may be present to introduce the study team members, they will not be involved in the recruitment and/or consent of the participants for the study. Aside from informational meetings to introduce the study and as necessary, provide feedback from study findings, no further cooperative community involvement will be conducted.

22) Sharing of Results with Subjects

Participating hospitals and communities will receive aggregate site-level data on PREDICT results from our testing platform, which is designed to detect novel viruses with unknown disease-causing potential. As this is a research study, results may not be available for several months. Summarized result reports with interpretations will not be provided for diagnostic purposes, nor could these be provided in a timeframe suitable for patient care.

The confidentiality of test results in the clinic and community will be upheld during this process by providing standardized, summary results reports for the community only. No identifiable information on human subjects will be included in these summary results reports. Because of the timeline for testing and results interpretation, we are not likely to provide results within a time frame that would be clinically relevant, therefore information provided by this project will not impact patient management or outlook.

23) Setting

The PREDICT project is focused in countries in the following regions:

South and Southeast Asia: countries include areas with densely populated tropical zones sometimes with extensive habitat modification; an active wildlife trade; close, potentially high-risk contact among wildlife, livestock, and humans; and documentation of previously emerging zoonotic pathogens including SARS coronavirus, MERS coronavirus, Nipah virus, highly pathogenic H5N1 avian influenza, and Ebola Reston.

Gangetic Plain: countries include areas with densely populated tropical zones sometimes with extensive habitat modification; an active wildlife trade; close, potentially high-risk contact among wildlife, livestock, and humans; and documentation of previously emerging zoonotic pathogens including outbreaks of avian influenza (H5N1) and Nipah virus have been recently documented.

Africa including West, North, Central and Eastern regions: countries include areas with high density human populations living in close contact with wildlife, which has enabled filoviruses such as Marburg and Ebola, and retroviruses such as HIV, and coronaviruses such as MERS, to spillover from animals into humans.

For a detailed list of countries led by each PREDICT Consortium partner and including local implementing partners, please see Appendix A.

Human sampling sites: In-country strategies for accessing individuals within the three critical pathways of disease emergence and spread in Asia and Africa (land conversion from commercialization, intensification of animal production systems, and animal value chains) rely on our strong relationships with local teams. Local team members, including health professionals, scientists, educators, and ministry officials will introduce the human sampling and the questionnaire to all targeted communities.

Potential research subjects will be identified and recruited by field research staff, working in collaboration with Ministries of Health, Environment, and Livestock/Agriculture. After informed consent is received, biological samples will be collected from subjects at designated local clinics or research sites or through home visits, as coordinated with local authorities by the in-country team. Questionnaires will be administered during the same participant session. Each PREDICT country lead will develop a recruitment/enrollment plan for each year of the project, attempting to target critical pathways for disease emergence and spread. PREDICT project sites include wild or domestic animal markets, farms, restaurants, animal sanctuaries, zoos or reserves, and extractive industries that lead to land use change, such as logging or palm oil plantations. In most sites, hospitals and clinics serving communities of highly exposed individuals will also be included.

For more information on the process for local scientific and ethical review structure at the country-level see #20 and #25.

24) Resources Available

The study is supported by a USAID $100 million five-year cooperative agreement with the UC Davis One Health Institute. The PREDICT Consortium has a research presence

and years of field experience in most of the PREDICT project countries. The Consortium has partnered with relevant government ministries, veterinary and public health universities, and research institutions in these countries.

Personnel

University of California:

Jonna Mazet, DVM, MPVM, PhD – Project PI.
Dr. Mazet is a Professor in the UC Davis Department of Medicine and Epidemiology and Executive Director of the UC Davis One Health Institute. She has served as the mentor for more than 50 graduate students and postdoctoral fellows and has published over 100 peer-reviewed scientific publications. Dr. Mazet's research focuses on One Health and the promotion of wellness at the wildlife-human domestic animal interface; disease ecology, especially zoonoses; the role of health in endangered species recovery and conservation; risk assessment for informed wildlife management and sound environmental policy; the development and optimization of diagnostic tests for free-ranging wildlife; and the use of key wildlife species as biomarkers of environmental health. Dr. Mazet has received in excess of $80 million in contracts and grants during the past two academic years. Additionally, she is the PI and Global Director of the PREDICT Project, the world's most comprehensive zoonotic disease surveillance and capacity strengthening project. She is overseeing all aspects of this project.

Christine Kreuder Johnson, VMD, PhD – Project Co-PI.
Dr. Johnson is Professor of Epidemiology in the UC Davis Department of Medicine and Epidemiology and Senior Biological and Ecological Surveillance Coordinator for the USAID's Emerging Pandemic Threats PREDICT program. She has led surveillance programs and large-scale population health investigations to inform state and federal agencies on wildlife health and emerging diseases for the past twenty years. She has developed and implemented risk-based approaches to integrate animal and human surveillance and standardized measures of risk assessment to enable systematic data analysis across a range of field studies from the local to global scale. At the One Health Institute, she has directed scientific investigations on wildlife health and conservation, disease events, and threats to public health for state and federal agencies. Since 2009, Dr. Johnson has served as epidemiologist for PREDICT project, designing global surveillance activities to identify infectious disease threats at high-risk animal-human interfaces in Africa and Asia and working with host country governments and international organizations to meet global health priorities and implement concurrent animal and human surveillance to detect zoonotic disease transmission. She will direct biological and syndromic surveillance activities and ensure epidemiologic support for characterization of high-risk animal-to-human disease transmission interfaces.

Tracey Goldstein, PhD – Project Co-PI.
Dr. Goldstein received her PhD from the Graduate Group of Comparative Pathology at UC Davis in September 2003. Following her completion of the PhD program, she completed two post-doctoral programs, one at the Alaska SeaLife Center in Seward

Alaska where she focused on health and diseases in free-ranging sea otters and Steller sea lions in Alaska and Russia, and a second one at The Marine Mammal Center in Sausalito, California where she managed a three-year NOAA-funded Oceans and Human Health Initiative Grant examining the long-term effects of the biotoxin domoic acid on the health and survival of California sea lions as a model for sentinels of human health. She obtained a Research Faculty position at UC Davis in December 2007, overseeing and managing the development of the research and viral diagnostic laboratory for the Wildlife Health Center and One Health Institute. She continues in this position where she now co-manages two objectives and directs one objective for the USAID-funded PREDICT project. Dr. Goldstein has extensive experience in molecular methods and has conducted research on adenoviruses and other pathogens, publishing 26 papers on wildlife and wildlife disease in the past 10 years. She will oversee laboratory work and analyses.

David Wolking, MSc - Global Operations Officer.
Mr. Wolking received his MSc in International Agricultural Development from UC Davis in 2009 with a focus in epidemiology and zoonotic diseases. He has 10 years of experience managing USAID-funded projects in health and natural resource management and has collaborated with and managed multi-national teams in East Africa and South Asia at the interface of health, livelihood improvement, and sustainable agriculture. Since 2009, Mr. Wolking has supported the PREDICT project in the development and implementation of global zoonotic disease surveillance and capacity strengthening programs, managed the country-level programs in Tanzania and Nepal, and directly supported the institutional development of diagnostic laboratories at the Sokoine University of Agriculture's Faculty of Veterinary Medicine and Public Health. He is currently engaged as Global Operations Officer for PREDICT, managing technical operations including coordination of ethical clearances and permissions for human subjects research and supporting the PI to ensure compliance across all sites.

Metabiota:

Nathan Wolfe, DSc, - Metabiota-sub PI.
Dr. Nathan Wolfe is the Lorry I. Lokey Business Wire Consulting Professor in Human Biology at Stanford University. He is Founder and CEO of Metabiota, a company that provides research-based biosurveillance tools to government customers. He is Founder and Chairman of Global Viral, a non-profit that promotes understanding, exploration and stewardship of the microbial world. Dr. Wolfe received his doctorate in Immunology & Infectious Diseases from Harvard in 1998. The recipient of a Fulbright fellowship in 1997, he was awarded the National Institutes of Health (NIH) International Research Scientist Development Award in 1999 and the NIH Director's Pioneer Award in 2005. In 2009, Dr. Wolfe was chosen as a National Geographic Emerging Explorer and in 2010 the World Economic Forum named him a Young Global Leader. Dr. Wolfe has published 90 technical articles and book chapters. His work has been published in or covered by Nature, Science, The Lancet, PNAS, JAMA, The New York Times, The Economist, Wired, Discover, Scientific American, NPR, Popular Science, Seed, The New Yorker, National Geographic Magazine, and Forbes. He has extensive consulting experience and has served on a number of advisory and editorial boards, including, the editorial board of

EcoHealth, the Board of Advisors of Scientific American and DARPA's Defense Science Research Council (DSRC). Dr. Wolfe has over eight years of experience living and conducting biomedical research in Southeast Asia (Malaysia) and sub-Saharan Africa (Cameroon and Uganda). He currently coordinates activities of over 50 scientists and staff from countries around the world and research activities in Cameroon, Chad, China, Democratic Republic of Congo, Equatorial Guinea, Gabon, Indonesia, Malaysia, Republic of Congo, Sierra Leone, Uganda, Ukraine, and Vietnam.

Damien Joly, PhD, Metabiota's Director of Epidemiology.
For over 15 years, Dr. Joly has worked at the interface of human, livestock, and wildlife health, developing field and quantitative techniques to identify the potential consequences of disease outbreaks for wildlife, livestock, and human health; describing spatial and temporal patterns to inform risk assessment and disease management actions; and designing, implementing, and evaluating the efficacy of wildlife disease management options. Dr. Joly is an expert in the development of wildlife health information management systems, having lead a team that developed a global wild bird avian influenza database and most recently with the Emerging Infectious Disease Information Technology Hub (EIDITH), used to collect, manage, and distribute information on over 250,000 wildlife diagnostic specimens collected from 20 countries around the world. Dr. Joly has given 58 invited and contributed scientific presentations and has authored or co-authored 35 peer-reviewed publications since 2000. Dr. Joly has worked on USAID-funded zoonotic disease surveillance projects since 2006, most recently the USAID Emerging Pandemic Threats PREDICT project, for which he serves as information management coordinator and directs Metabiota's overall contribution to the project, including zoonotic disease surveillance in ten countries in Asia and Africa. In addition to Metabiota's Director of Epidemiology, Dr. Joly holds an appointment as Adjunct Associate Professor in the Department of Ecosystem and Public Health, Faculty of Veterinary Medicine, University of Calgary.

Karen Saylors, PhD Metabiota Senior Director, Behavioral Risk Analytics & PREDICT Deputy Director of Behavioral Surveillance.
Dr. Saylors has been working as a medical anthropologist in the public and behavioral health arenas for 18 years, designing, implementing, and managing multicultural health research projects. After receiving her MA working with francophone traditional healers in Louisiana and her PhD in Medical Anthropology from the Université de Montréal, Dr. Saylors conducted applied research as the Director of Research and Evaluation for a Native American non-profit organization, focused on HIV and community-based participatory research, for Navajo Nation, researching traditional and Western treatment modalities and for the New Mexico Department of Public Health conducting population based disease surveillance and field epidemiology. Since 2006, she has run public health research programs for Médecins Sans Frontiers and Metabiota in central Africa and southeast Asia, focused on HIV and zoonotic disease surveillance, exploring behavioral risk, perception, and change in high-risk populations. During the first USAID Emerging Pandemic Threats award, Dr. Saylors worked with the PREVENT project on risk characterization and formative behavioral change research in central Africa and in this second round is the Deputy Director of Behavioral Surveillance for PREDICT.

Corina Monagin, DrPH - Metabiota Director, PREDICT Surveillance Operations.
Dr. Monagin has been working in the international public health field for over 10 years. She received her Bachelor's degree in Biological Anthropology from The George Washington University and her MPH in International Health Systems Management from Tulane University. She received her Doctor of Public Health degree (DrPH) and a Diploma for post-graduate studies (DLSHTM) at the London School of Hygiene and Tropical Medicine for her work on emerging infectious disease policy in SE Asia. Dr. Monagin has many years living abroad working to establish global surveillance networks. She spent several years working in collaboration with the World Health Organization and Tulane University in West Africa developing an international infectious disease laboratory network and assisted in increasing laboratory diagnostic capacity throughout the region. Based in Guangzhou, China, she provided logistical and research operational support for sites in China and SE Asia, increasing capacity to control and respond to emerging infectious diseases in the region, including coordinating international outbreak response teams. Now back in the USA, she oversees wildlife, livestock, and human surveillance programs across the globe.

EcoHealth Alliance:

Peter Daszak, PhD - EHA President and PREDICT Modeling & Analytics Operations Lead.
Dr. Peter Daszak is President of EcoHealth Alliance, a US-based organization that conducts research and outreach programs on global health, conservation, and international development. Dr. Daszak has published extensively on the origins and drivers of Avian Influenza, Nipah virus, SARS, Middle Eastern Respiratory Syndrome (MERS), and global trends in disease emergence and pandemic risk. His seminal work on EID 'hotspots' formed the geographical focus for PREDICT-1, in which he successfully led the modeling objective to produce 'Hotspots II' and a range of other analytical products published in more than 50 key papers in The Lancet, Nature, PNAS, EID, and other leading journals. His research has been instrumental in identifying and predicting the impact of emerging diseases across the globe. His achievements include identifying the first case of a species extinction due to disease, the discovery of the disease chytridiomycosis as the cause of global amphibian declines, identification of the bat origin of SARS, identifying the causes of Nipah and Hendra virus emergence, coining the term 'pathogen pollution', and producing the first ever global emerging disease 'hotspots' map. Dr. Daszak is a member of the Institute of Medicine's Forum on Microbial Threats, and served on the IOM Committee on global surveillance for emerging zoonoses, the NRC committee on the future of veterinary research, the International Standing Advisory Board of the Australian Biosecurity CRC, and he has advised the Director for Medical Preparedness Policy on the White House National Security Staff on global health issues. Dr. Daszak won the 2000 CSIRO medal for collaborative research in the discovery of amphibian chytridiomycosis and is currently Editor-in-Chief of the journal EcoHealth. He has authored over 200 scientific papers, and his work has been the focus of extensive media coverage, ranging from popular press articles to television appearances.

Maureen Miller, PhD - PREDICT Senior Behavioral Surveillance Coordinator.
Dr. Miller, based at EcoHealth Alliance, is a social scientist with degrees in both epidemiology and medical anthropology. She maintains an active faculty appointment in the Department of Epidemiology at the Mailman School of Public Health, Columbia University. Dr. Miller has extensive experience in applied infectious disease prevention research, programming and policy. Dr. Miller, together with Dr. Saylors, provides the technical leadership for the behavior portion of this study. Dr. Miller will provide critical leadership for the behavior portions of all participating country teams and will support training and implementation, data analysis, and results communications.

Emily Hagan, MPH – Research Coordinator.
Ms. Hagan is a Research Coordinator based at EcoHealthAlliance and has a BS in biology and biomedical sciences, an MPH in epidemiology from Columbia University, and an extensive background in infectious disease immunology. Ms. Hagan supports Drs. Miller and Saylors in the design and implementation of the behavior portion of this study, and will provide support and training to local country teams during implementation and analysis.

Smithsonian Institution:

Dr. Suzan Murray – Smithsonian Institution PREDICT Project Lead
Dr. Suzan Murray Heads the Smithsonian's Global health program (SGHP), which addresses urgent global needs and opportunities in emerging diseases and conservation medicine. As a Smithsonian scientist, she engages in a variety of studies related to emerging diseases, biodiversity, and wildlife health. She is the liaison to the Foreign Animal Disease Threat and Pandemic Preparedness subcommittees of the Office of Science and Technology. She received her DVM from Tufts University and is a Diplomat of the American College of Zoological Medicine. Suzan is currently the Project lead for Smithsonian's PREDICT programs in Myanmar and Kenya.

Dr. Kali Holder - Smithsonian Institution Postdoctoral Fellow
Dr. Kali Holder is the Morris Animal Foundation Global Health Fellow and a board certified Veterinary Pathologist. Her research with the Smithsonian is on emerging skin diseases in rhinoceros and giraffe of East Africa and emerging zoonotic diseases in Kenya and Myanmar through the PREDICT program. Dr. Holder received her DVM from the University of Florida and previously completed a postdoctoral research program with the San Diego Zoo's Institute for Conservation Research. Her primary interests are in emerging diseases and applications of pathology and advanced diagnostics to conservation goals.

Wildlife Conservation Society:

Amanda Fine, VMD, PhD - WCS Associate Director & Project Lead
Dr. Fine is the Associate Director, Asia for the Wildlife Health & Health Policy Program at the Wildlife Conservation Society (WCS). Dr. Fine is a graduate of Swarthmore

College and has a degree in veterinary medicine from the University of Pennsylvania and a PhD in Veterinary Epidemiology from Michigan State University. In Mongolia, she opened and staffed the WCS Country Program office in Ulaanbaatar and her principal responsibilities have included oversight for two large landscape-level conservation projects funded by USAID. Dr. Fine now leads the health program in Asia and coordinates WCS wildlife health projects in Vietnam where she is based. Dr. Fine has also been involved in implementing wildlife health projects in Mongolia focused on avian influenza in wild birds and Foot and Mouth Disease (FMD) in wild and domestic ungulates. She has a strong interest in disease at the interface of human, livestock and wildlife health and has conducted research in the U.S. and internationally on brucellosis, parasitic nematodes and bovine tuberculosis. Dr. Fine has an adjunct appointment in the Department of Large Animal Clinical Sciences, College of Veterinary Medicine, at Michigan State University. She is currently serving as WCS's Project Lead for PREDICT.

Sarah Olson, PhD - WCS Wildlife Epidemiologist & Scientific Advisor
Dr. Olson is the Associate Director, Wildlife Epidemiology for the Wildlife Health & Health Policy Program at the Wildlife Conservation Society (WCS). She received a joint PhD in Population Health and Environment & Resources from the University of Wisconsin-Madison and studied how deforestation and climate affect malaria incidence in the Amazon. She has also studied regional landscape drivers of Lyme disease in North America. Dr. Olson's portfolio also includes research on the wildlife trade, avian influenza, Ebola, digital disease detection, and surveillance techniques for free-ranging wildlife. Her broad research interest focuses on the intersection of wildlife, human, and environmental health. She is currently serving as WCS's Wildlife Epidemiologist & Scientific Advisor for PREDICT.

25) Prior Approvals

PREDICT Consortium partners will rely on the UC Davis IRB for review and approval. Authorization agreements establishing UC Davis as the Reviewing IRB of Record have been established with EcoHealth Alliance and Metabiota, Inc. under award AID-OAA-A-14-00102. Documentation for each authorization agreement has been provided in the appendices. Authorization agreements to establish UC Davis as the Review IRB of Record are currently in development with the Wildlife Conservation Society and Smithsonian Institution.

Prior to commencing research at specific sites, we will seek approval of this study from all participating countries through Institutional Review Boards, ethical clearance councils/committees, and national research administrations following local regulatory guidelines as appropriate. Separate IRB protocols for each country and any amendments to locally approved research protocols or consent forms diverting from Master Protocol activities will be submitted to the UC Davis IRB Administration for review.

26) Provisions to Protect the Privacy Interests of Subjects

If an individual decides to participate in this research, his/her participation and all information provided by the participant will be strictly confidential, and personal identifying information will not be shared with anyone outside of the research staff.

Interview locations will be identified before the interview and will be conducted in a quiet and private place in areas where there are no other individuals present within a 10-foot distance. Specific sites for interviews depend on the type of targeted community and may be inside wildlife restaurants, behind animal storage sheds, in private rooms if in dwellings or in offices of business owners, etc. A barrier will be created so that no other individuals can view the participants while they are in their interview. Depending on the location, this could be a private room, behind a building or fence, or behind a line of trees, obstructing view so that confidentiality may be maintained. For clinics, questionnaires will be conducted one on one in a personal office.

Biological specimen collection will be conducted in private areas, such as in a private room in a dwelling, or behind a curtain or similar barrier. All efforts will be made to ensure the privacy and confidentiality of participants.

Participants will not be identified or named in any reports or publications. Questionnaire information and all biological samples will be identified by an alphanumeric code, not by the participant’s individual name. All records that contain names or other personal identifiers, such as informed consent forms and the confidential participant logbook, will be stored separately from study records. All personal information will be stored securely at the study site in locked files cabinets or password protected devices in areas with access limited to research staff. Study databases will be secured with password-protected access systems and controlled distribution web-based certificates and will not contain any identifying characteristics in relation to study participants (e.g. name, address, or telephone number). Access to all data will be limited to staff involved in this study. The health information disclosed by an individual will not be used by or disclosed (released) to another institution. Any surveillance report that is published or shared with partners will not contain any personal identifying information for individual participants.

27) Compensation for Research-Related Injury

The proposed biological sample collection poses minimal risk of injury to study subjects.

28) Economic Burden to Subjects

As stated previously, care will be taken to conduct interviews and sampling in private and secure locations to ensure participant confidentiality. There will be no cost for subjects to participate in the study. In some cases, outside of clinic settings, interviews and sampling may require time away from potential livelihood activities and participants will be offered a gift or token of appreciation as compensation (See #9 “Compensation to the Subjects”).

PREDICT will cover the costs of any testing that is done for this study. Participants will not be charged a fee for proposed tests. Aggregated summary test result reports will be provided to clinicians presenting data at the community level. These reports might show that one of the participants in the community was infected with a virus that may or may not have an available treatment. However, for the viruses targeted by this protocol, testing and interpretation of results will not be completed in a timeframe that is clinically relevant for disease-causing pathogens. Therefore, PREDICT would not be in a position to support ongoing patient care or treatment costs, if such treatment exists.

In the event PREDICT is requested by the host country government to assist in investigation of a disease outbreak, we will attempt to provide test findings on a timeline that is relevant to disease control in the outbreak situation. In the event serious infectious diseases that may be transmitted to other humans are detected, participant identity may be shared with public health officials as required by host country law or health regulations to expedite disease control.

29) Consent Process

We will be following the SOP: Informed Consent Process for Research (HRP-090). Informed consent forms including the associated project information script are attached to this protocol (Appendix B).

Only consented participants will be enrolled in the research. No research procedures will be undertaken before the participant agrees to enroll in the study and signs a consent form. For the purposes of this study, anyone under the age of 18 years and over the age of 2 years will be considered a child and will be eligible to participate in the research if they meet the aforementioned inclusion criteria. In countries where the age of majority is less than or more than 18 years old, the country-level IRB will specifically describe the age range with corresponding updates to all consent forms. Pregnant women will also be eligible to participate if they meet the above-mentioned inclusion criteria. For children to participate, consent will be required from a parent or legal guardian. For hospitalized patients only, if the patient is judged by the staff to be unfit or unable to provide informed consent, an acknowledged representative (family member) may provide consent on their

behalf. If the patient becomes able to consent during the course of the study, the subject will be asked to consent for continuation in the study.

If participants meet the criteria for enrollment, they will be invited to discuss the details of the study. The study staff will review an information sheet and informed consent form with the participant/representative, provide a copy of the information sheet and informed consent form, and explain the details of the study including the study procedures, risks and benefits, financial and confidentiality considerations, alternatives to participating, and how to obtain more information. This process will take approximately five minutes, and the statement will be read in the local language of the country site and in a location ensuring patient or participant privacy as described above. Protocols and informed consent statements for this study will be translated into the local language of the country site. Research team members involved in this consent process will be required to be fluent in the local language in order to ensure that the subjects understand the study and the procedures. Specific country protocols will indicate translated languages and provide copies of all translated documents. For this global master protocol, we are submitting consent forms in English only (Appendix B – PREDICT Informed Consent Form).

The study staff will invite the participant/representative to ask questions and will endeavor to ensure that s/he understands the information provided. The study staff will then ask the participant/representative to consider study participation. Participants will have as much time as required to consider participation. All participants/representatives will be required to sign a consent form. For participation of a child, parent or legal guardian will be present and sign the parental consent form. Parents or guardians of the child will be read a statement describing the study and the benefits and potential risks of participating in the study in a private room by a trained research team member. Date of birth of children will be estimated by asking a parent the age of the child. Children not accompanied by a parent/guardian will not be allowed to participate. Capacity to consent will be evaluated by trained members of the research team with care taken to ensure that only participants that have clearly followed and fully understood the study, along with all associated benefits and risks will be consented.

Those who consent to the study will sign and date two copies of the consent form. The study staff will also sign and date the two copies. A copy of the signed consent must be provided to the subject. If the participant is illiterate, a witness who is not a member of the study staff will be present during the informed consent discussion. The consent form will be read to the participant in the presence of the witness. If the participant agrees to participate, the form will be signed and dated by the witness. In this case, the participant or representative will still be invited to make a mark (e.g., written mark or a thumbprint) in a dedicated location of the form (See Appendix B).

For hospitalized patients, those who refuse to participate or to sign the consent form will be treated with the best available standard of care and will not have any study related procedures performed; no negative repercussions will result from refusal to participate. Informed consent paperwork will be kept for a minimum of three years in a locked box at the local country PREDICT office.

PREDICT global and consortium staff, regional leads supervising surveillance, and country coordinators supervising local implementation of human subjects research will receive Collaborative Institutional Training Initiative (CITI) training for Biomedical Researchers and Staff. Trained staff will supervise activities and observe the consent process to evaluate the local clinical personnel's capacity to obtain informed consent from subjects involved in research. Specifically, CITI trained staff will review the consent form with staff implementing research activities to explain and clarify procedures, observe staff obtaining consent, and review consent forms to ensure compliance and completeness.

30) Process to Document Consent in Writing

We will be following the process as described in "SOP: Written Documentation of Consent (HRP-091)."

31) Drugs or Devices

Not applicable – No drugs or devices will be used in this study.

References

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Murray, K.A., and P. Daszak. 2013. Human ecology in pathogenic landscapes: two hypotheses on how land use change drives viral emergence. Current Opinion in Virology 3:79-83.

Smolinski, M.S., M.A. Hamburg, J. Lederberg (editors), and Committee on emerging microbial threats to health in the 21st Century. 2003. Microbial threats to health: emergence, detection, and response. Washington, DC: The National Academies Press.

Taylor, L.H., S.M. Latham, and M.E.J. Woolhouse. 2001. Risk factors for human disease emergence. Philosophical Transactions of the Royal Society of London B 356: 983-989.

PREDICT INFORMED CONSENT FORM

Adult Participant or Child Participant's Parent/Guardian Information Sheet

Study Title: PREDICT - Surveillance for Emerging Zoonotic Disease Threats and Behavioral Risk Characterization in High-risk Communities in Asia and Africa

Subjects Description: Research subjects to be enrolled in this study are those living, working, or visiting the locations selected by the PREDICT project team as important to monitor for new diseases in two settings: 1) people with close contact with wildlife and livestock; and 2) sick patients at clinics or hospitals.

Study Point of Contact: [Country Specific POC]
Lead Principle Investigator: Professor Jonna A.K. Mazet, University of California, Davis

Sponsor: USAID Emerging Pandemic Threats Program, PREDICT Project
Institutions Implementing the Study: [Country Implementing Partner(s)]

I. Introduction

We would like you or your child to participate in a study entitled **"PREDICT - Surveillance for Emerging Zoonotic Disease Threats and Behavioral Risk Characterization in High-risk Communities in Asia and Africa"**. Emerging disease threats could come from animals and make people sick. Before you read more information about this study and decide to provide your consent for participation, it is very important that you understand the following general principles, which apply to all participants in this study:

1. Participation in this study is entirely voluntary.
2. After providing your consent to participate, your may decide to withdraw from this study or decline any part of the study, at any time, without giving a reason for withdrawal. Withdrawal of your consent will not prevent or otherwise affect you or your child from receiving routine health care.
3. After you read the explanation provided below, please feel free to ask any questions that will allow you to clearly understand the study.

II. What is the purpose of the study?

The purpose of this study is to see if people living here might be getting new diseases from animals. The study will help us learn more about diseases people can get from activities such as hunting, butchering, raising, and eating animals. This information will be used to help us learn about diseases in your community and how new diseases might arise. The work may help us to discover ways to reduce the risk of catching these types of diseases.

The *[insert community/clinic/hospital]* is collaborating in this study. This project is a collaborative effort with *[insert in-country implementing partner]* and the University of California Davis and *[Consortium partner]* in the United States. As part of this research we are collecting samples from people in *[insert local country]* and asking them questions about their contact with wildlife and livestock.

I am here today to ask if you, or you on behalf of your child, are willing to consent to participating in this study by talking with me, responding to survey questions about your contact with animals and providing a sample that may include blood, swabs from

your mouth, nose, or rectum, as well as urine, and feces. The survey and sample collection will take approximately one hour.

III. What procedures will be performed on participants?

If you, or your child, are eligible and interested in participating, your or your child will be enrolled into the study. The study will involve the following procedures:

1. The first procedure will be to complete and sign the form included at the end of this document. If you are a parent or guardian of a child participant, your child will be asked to provide agreement if they are 12 years or older. You (and your child if relevant) will do this only after you have read this document and received explanation from one of the study members.
2. You, or your child, will then be enrolled in the study, and we will collect some information from you including questions about your family, livelihood, past diseases, and your activities with wildlife and livestock.
3. Once you, or your child, are found eligible and are still interested in participating in the study some of the following samples may be collected:
    a. Two swabs (soft tipped sticks) swiped against the inside of your mouth or back of your throat.
    b. Two swabs (soft tipped sticks) swiped against the inside of your nose or behind your nose.
    c. A small amount of blood (approximately two teaspoons) taken from a vein in your arm.
    d. A sample of your feces or rectal swab (soft tipped sticks swiped against the inside of your rectum)
    e. A sample of your urine or a urogenital swab (soft tipped sticks swiped against the inside of your urethra)
    f. If you are a patient in a hospital and your doctor or care provider has already collected or will be collecting these samples or samples like cerebral spinal fluid (fluid from your spinal column) pericardial fluid (fluid from around the heart), or pleural fluid (fluid from around your lungs) to test for diseases, we will ask your permission to use some of this material in our study.
4. After samples are collected, they will be tested in a laboratory. A summary of the diseases and the findings at this site will be provided to your physician and/or local health officials during the study period. Your personal identification will not be linked to the summary of findings, and your participation will be confidential.

IV. What is the duration of study and participation?

The entire study will last for up to ten years, but sample collection and questions about you or your child's participation may only take one day and should take no more than one hour. If you, or your child, are admitted to a participating hospital or clinic on a different occasion, additional samples may be collected if appropriate.

V. What are the benefits of participation?

You, or your child, will benefit from having been checked for viruses that can be transmitted from animals, as this information will be used to discover ways to avoid or limit disease outbreaks in your community..

VI. Are there any risks or burdens associated with participation?

Minimal discomfort or harm is anticipated during the collection of samples for this study. Minor discomfort may occur during gentle rubbing for swab sample collection.

Bleeding, bruising, soreness or local infection may occur during blood sample collection at the needle site; these are expected to be very minor and to not need treatment unless directed by your doctor.

After receiving summaries of our findings for this site, your physician may communicate with you about diseases in your community. We will provide your doctor or medical care providers with information on these findings so they can talk with you about risk to you or your family and ways to prevent diseases. Because laboratory analysis for these samples takes many months, we will not be able to provide findings to your doctor within time to help with treatment for a disease you have already.

Your answers to a few questions might include activities that are against the local laws. To minimize risk of consequences from authorities, all information will be collected in a strictly confidential manner and stored securely to protect your privacy.

VII. Will participants receive any compensation or payment?

There will be no payment made for your participation. However, you may receive a token of appreciation for your participation.

VIII. May I refuse to participate or withdraw from the study?

Your decision to participate in this study is **completely voluntary**, and you will neither **be influenced nor forced to participate.** You may withdraw from participation **at any time**. Your decision **not** to participate or to **withdraw** your consent to participate will not affect your right to receive care or medical attention.

IX. Will my data and samples be kept confidential?

Information that you or your child provide(s) and laboratory results will remain confidential and will only be used in this study. Information and test results will be coded so that your answers and results are not linked to your name, and information will be kept secured by the study team.

All collected samples and surveys will be coded using a unique identification code assigned to each individual. All records that contain names and other personal identifying information will be stored separately from survey question information and laboratory results. Personal information will be secured in locked facilities and on password protected devices with limited access by study staff. Your health information will not be used by or disclosed (released) to another institution. Any documents produced or reports published or shared will not contain your personal identifying information.

X. Who can I contact if I have questions?

If you have any questions or need clarification at any time before signing the consent form or during the study period, do not hesitate to ask the study team members that have provided you with this information. You can also contact the Lead Principal Investigator at UC Davis or the primary Point of Contact for the country implementing partner *[NAME]* if you have any questions or need clarification related to this study or related to your participation.

Lead Principal Investigator:	Professor Jonna A.K. Mazet, UC Davis
Phone/Email:	+15307527526/predict@ucdavis.edu
Local Contact:	*[Local implementing partner contact]*
Phone:	
Email:	
IRB Contact:	*[Local IRB or ethical committee approving study]*
Phone:	
Email:	

CERTIFICATION BY A VOLUNTEER (ADULT CONSENT)

I, _____(Volunteer Name and Surname) attest to have received explanation about the aim and procedures of the study entitled above.

I attest to have been given enough time to read the information script above that describes detailed study procedures, including samples to be collected.

I attest to have understood the aim, procedures, benefits and risks and that I was given sufficient time to ask my questions related to the procedures, benefits and risk of my participation and I have received satisfactory answers. I understand that if I have further questions I can contact the study team by telephone or mail using the contact information above.

I also agree that my blood or other samples and related information will be stored for up to ten years and that my personal information will be kept in a secure and protected manner. At the end of this study in ten years, all samples, as well as all accompanying information, will be destroyed.

I VOLUNTARILY AGREE TO PARTICIPATE in the study referenced above.
I understand that I have the right to withdraw my consent at any time.

I do understand that I can be withdrawn, or that the study could be terminated by the principal investigator, for my benefit and/or the benefit of the study. I understand I will be given a copy of the information sheet and consent form to keep for my records.

☐ I consent to full participation in the survey and sample collection for this study.

☐ I consent to participate in ONLY the survey portion of this study.

☐ I decline to participate in this study.

Unique ID: _____ **Date:** _____

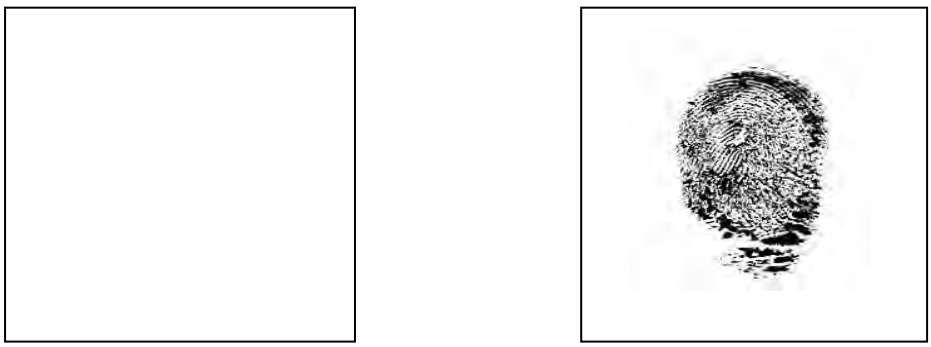
NAME OF PARTICIPANT (PRINT)		
First Name:	Middle Name:	Surname:
Date *(dd/mm/yyyy)*: |__|__|/|__|__|/|__|__|__|__|	Time *(24 hrs):* |__|__|:|__|__|	Signature:

I have accurately read or witnessed the accurate reading of the consent form to the potential participant, and the individual has had the opportunity to ask questions. I confirm that the individual has given consent freely.

NAME OF PERSON GIVING CONSENT EXPLANATION (PRINT)		
First Name:	Middle Name:	Surname:
Date *(dd/mm/yyyy)*: |__|__|/|__|__|/|__|__|__|__|	Time *(24 hrs):* |__|__|:|__|__|	Signature:

IF PARTICIPANT IS ILLITERATE

THUMB PRINT (OR OTHER MARK) OF PARTICIPANT



I have witnessed the accurate reading of the consent form to the potential participant, and the individual has had the opportunity to ask questions. I confirm that the individual has given consent freely.

NAME OF WITNESS (PRINT)		
First Name:	Middle Name:	Surname:
Date *(dd/mm/yyyy)*: |__|__|/|__|__|/|__|__|__|__|	Time *(24 hrs):* |__|__|:|__|__|	Signature:

CHILD PARTICIPANT'S PARENT/GUARDIAN CONSENT FORM

I, _____ (Parent/Guardian's Name) consent to the voluntary participation of my child _____(Child's Name) as a participant in the study, and understand that I have the right to withdraw him/her from the research at any time without it in any way affecting his/her medical care.

I attest to have received explanation about the aim and procedures of the study entitled above.

I attest to have been given enough time to read the information script above that describes detailed study procedures, including samples to be collected.

I attest to have understood the aim, procedures, benefits and risks and that I was given sufficient time to ask my questions related to the procedures, benefits and risk of my child's participation and have received satisfactory answers. I understand that if I have further questions I can contact the study team by telephone or mail using the contact information above.

I also agree that any of my child's blood or other samples and related information will be stored for up to ten years and that the child's personal information will be kept in a secure and protected manner. At the end of this study in ten years, all samples, as well as all accompanying information, will be destroyed.

I VOLUNTARILY AGREE TO MY CHILD'S PARTICIPATATION in the study referenced above.
I understand that I have the right to withdraw my consent for my child's participation at any time. I do understand that my child can be withdrawn, or that the study could be terminated by the principal investigator, for my benefit and/or the benefit of the study. I understand I will be given a copy of the information script above and consent form to keep for my records.

☐ I consent to the full participation of my child in the survey and sample collection for this study,

☐ I consent to the participation of my child in ONLY the survey portion of this study.

☐ I decline to consent for my child to participate in this study.

Unique ID: _____ **Date:** _____

CHILD'S NAME (PARTICIPANT) (PRINT)		
First Name :	Middle Name:	Surname:

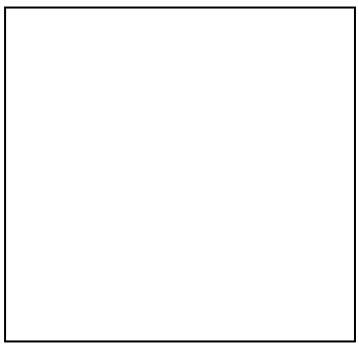
PARENT'S/GUARDIAN'S PRINTED NAME (PRINT)		
First Name:	Middle Name:	Surname:
Date *(dd/mm/yyyy)*: |__|__|/|__|__|/|__|__|__|__|	Time *(24 hrs)*: |__|__|:|__|__|	Signature:

I have accurately read or witnessed the accurate reading of the consent form to the parent/guardian of potential participant, and the individual has had the opportunity to ask questions. I confirm that the individual has given consent freely.

NAME OF PERSON GIVING CONSENT EXPLANATION (PRINT)		
First Name:	Middle Name:	Surname:
Date *(dd/mm/yyyy)*: |__|__|/|__|__|/|__|__|__|__|	Time *(24 hrs):* |__|__|:|__|__|	Signature:

IF PARENT/LEGAL GUARDIAN IS ILLITERATE

THUMB PRINT (OR OTHER MARK) OF PARTICIPANT



I have witnessed the accurate reading of the consent form to the potential participant, and the individual has had the opportunity to ask questions. I confirm that the individual has given consent freely.

NAME OF WITNESS (PRINT)		
First Name:	Middle Name:	Surname:
Date *(dd/mm/yyyy)*: |__|__|/|__|__|/|__|__|__|__|	Time *(24 hrs)*: |__|__|:|__|__|	Signature:

CHILD ASSENT - ONLY APPLY IF CHILD IS BETWEEN 12-17 YEARS OLD

Assent

- ❑ Obtained
- ❑ Not obtained because the capability of the child is so limited that the child cannot reasonably be consulted.

I_____ (NAME AND SURNAME OF THE PERSON GIVING CONSENT EXPLANATION*)* attest that the child has provided **verbal assent** to participate in this study.

Date *(dd/mm/yyyy)*:	Time *(24 hrs)*:	Signature:
|__|__|/|__|__|/|__|__|__|__|	|__|__|:|__|__|	

Human Questionnaire Form

EIDITH V 1.1

1. Consent Form Administered & Signed ☐ yes ☐ no Participant ID:_____

2. Description of Interview Location - Select all that apply.
(To be completed by interviewer prior to administrative questionnaire.
Prepare and download modules in advance.)

- ☐ Animal Production or Abattoir Site
- ☐ Crop Production Site
- ☐ Extractive Industry Site
- ☐ Market or Value Chain Site
- ☐ Temporary Settlement Site
- ☐ Tourism Site
- ☐ Wildlife Restaurant
- ☐ Zoos or Sanctuaries
- ☐ Hospital or Clinic - Health Professional
- ☐ Hospital or Clinic - Patient
- ☐ Protected Area (eg. forest, public park)
- ☐ Other: _____

3. Date of interview _____

4. Begin time of interview _____
(Example: 17:50)

5. End time of interview _____
(Example: 19:20)

6. Where are you conducting this interview?

Village/Town/City _____ District _____ Province/State _____

Latitude _____ Longitude _____
Interviewer: Please collect GPS coordinates if administering using paper and pen.

7. Interviewer Observed Gender ☐ male ☐ female ☐ other

INTERVIEW/QUESTIONNAIRE BEGINS

Demographics Section (include observation question 7)

8. How old are you? _____
If the exact age is unknown, enter the respondent's estimated age.

9. Where do you live?

Village/Town/City _____ District _____ Province/State _____

Latitude _____ Longitude _____
Interviewer: Probe for landmarks or nearest known site if area unknown.
GPS coordinates to be identified and entered after completion of interview.

10. How long have you lived there? Select one option.
- ☐ <1 month
- ☐ 1 month - 1 year
- ☐ >1 - 5 years
- ☐ >5 - 10 years
- ☐ >10 years

11. How many other people live in the dwelling where you live? _____
Skip to question 14 if answer is 0.

12. How many in the dwelling are children less than 5 years old? _____

13. How many in the dwelling are male? _____

14. How many rooms are there in the dwelling where you live? _____
(Do not include bathroom or kitchen)

15. Is the dwelling a permanent structure (that cannot be moved)? ☐ yes ☐ no
Interviewer: If answer is no, complete temporary settlement questionnaire.

16. Do you get water from:
Select all that apply.
☐ piped in water/water taps
☐ covered well
☐ uncovered well/pond/river
☐ water truck/rainwater harvest
☐ other: _____

17. Do you treat your drinking water? ☐ yes ☐ no

18. If yes, how do you treat your water?
Select all that apply.
☐ boil
☐ filter
☐ add chlorine or bleach
☐ solar disinfection
☐ other: _____

19. Is your source for drinking water ever used by animals? ☐ yes ☐ no

20. In your dwelling is there a dedicated location for human solid waste/excreta? ☐ yes ☐ no
(Example: toilet, latrine, designated area)

21. Do you have containers for storing food for the household?
Select all that apply.
☐ yes, with covers
☐ yes, without covers
☐ no

Participant ID _____
(For reference only)

Livelihood Section

In this section, I'd like to ask you about education and the kinds of work activities that you have done since this time last year.

22. What is the highest level of education you have completed?
Select one option. (Skip for Cameroon.)

- ○ primary school
- ○ secondary school
- ○ college/university/professional
- ○ none

23. What is the highest level of education that your mother completed?
Select one option. (Skip for Cameroon.)

- ○ primary school
- ○ secondary school
- ○ college/university/professional
- ○ none

24. Since this time last year what are the activities you have done to earn your livelihood?
Select all that apply.

- ○ extraction of minerals, gas, oil, timber
- ○ crop production
- ○ wildlife restaurant business
- ○ wild/exotic animal trade/market
- ○ rancher/farmer animal production business
- ○ meat processing, slaughterhouse, abattoir
- ○ zoo/sanctuary animal health care
- ○ protected area worker
- ○ hunter/trapper/fisher
- ○ forager/gatherer/non-timber forest product collector
- ○ migrant laborer
- ○ nurse, doctor, traditional healer, community health worker
- ○ construction
- ○ other: _____

25. If more than one activity was selected, what is the activity on which you spent the most time since this time last year?*
Select one option.

- ○ extraction of minerals, gas, oil, timber
- ○ crop production
- ○ wildlife restaurant business
- ○ wild/exotic animal trade/market
- ○ rancher/farmer animal production business
- ○ meat processing, slaughterhouse, abattoir
- ○ zoo/sanctuary animal health care
- ○ protected area worker
- ○ hunter/trapper/fisher
- ○ forager/gatherer/non-timber forest product collector
- ○ migrant laborer
- ○ nurse, doctor, traditional healer, community health worker
- ○ construction
- ○ other: _____

26. Which best describes your job position?
Select one option.

- ○ manager/owner/foreman
- ○ worker
- ○ live and work at home independently (If chosen, skip to question 28)
- ○ professional
- ○ other: _____

27. Where do you work?

Village/Town/City _____ District _____ Province/State _____

Latitude _____ Longitude _____

Interviewer: Probe for landmarks or nearest known site if area unknown.
GPS coordinates to be identified and entered after completion of interview.

Participant ID _____
(For reference only)

Medical History Section

In this section, I'm going to ask you about any illness or sickness that is not known or recognized in the community, including by medical or treatment providers.

28. Where do you usually get treatment for medical problems? Select all that apply.
- ☐ clinic/health center
- ☐ hospital
- ☐ mobile clinic
- ☐ community health worker
- ☐ traditional healer
- ☐ dispensary or pharmacy

29. Have you ever had an unusual illness with any of the following symptoms: Select all that apply. (READ ONLY SYMPTOMS)
- ☐ fever with headache and severe fatigue or weakness (encephalitis)
- ☐ fever with bleeding or bruising not related to injury (hemorrhagic fever)
- ☐ fever with cough and shortness of breath or difficulty breathing (SARI)
- ☐ fever with muscle aches, cough, or sore throat (ILI)
- ☐ fever with diarrhea or vomiting
- ☐ fever with rash
- ☐ persistent rash or sores on skin
- ☐ no (Skip to question 33)
- ☐ yes but, none of these symptoms-describe: _____

30. Since this time last year, have you had any of these symptoms?
- ☐ yes
- ☐ no (Skip to question 33)

31. If yes, which ones? Select all that apply.
- ☐ fever with headache and severe fatigue or weakness (encephalitis)
- ☐ fever with bleeding or bruising not related to injury (hemorrhagic fever)
- ☐ fever with cough and shortness of breath or difficulty breathing (SARI)
- ☐ fever with muscle aches, cough, or sore throat (ILI)
- ☐ fever with diarrhea or vomiting
- ☐ fever with rash
- ☐ persistent rash or sores on skin
- ☐ none of these symptoms-describe: _____

32. In your opinion, when you were sick, what caused this sickness? Select all that apply.
- ☐ contact with sick people
- ☐ contact with wild animals
- ☐ contact with other animals
- ☐ bad food or water
- ☐ bad spirits/witchcraft
- ☐ wound or injury
- ☐ I don't know
- ☐ other: _____

33. Since this time last year, have any of the people you lived with had any of these symptoms?
- ☐ yes
- ☐ no (Skip to question 36)

34. If yes, which ones? Select all that apply.
- ☐ fever with headache and severe fatigue or weakness (encephalitis)
- ☐ fever with bleeding or bruising not related to injury (hemorrhagic fever)
- ☐ fever with cough and shortness of breath or difficulty breathing (SARI)
- ☐ fever with muscle aches, cough, or sore throat (ILI)
- ☐ fever with diarrhea or vomiting
- ☐ fever with rash
- ☐ persistent rash or sores on skin
- ☐ none of these symptoms-describe: _____

35. Since this time last year, did anyone you lived with die from this illness?
- ☐ yes
- ☐ no

Participant ID _____
(For reference only)

Movement Section

In this section, I'm going to ask you about any travel you have done since this time last year.

36. Have you traveled since this time last year? ☐ yes ☐ no
If answer is no, skip to the next section.

37. Where have you traveled since this time last year? Anywhere else?

Provide details, such as name of town, nearest (or most frequent) well known place if unknown by interviewer (to be linked to GPS coordinates later)
Collect up to 6 locations.

Interviewer: Probe for landmarks or nearest known site if area unknown. GPS coordinates to be identified and entered after completion of interview.

Village/Town/City _____ District _____ Province/State _____

Latitude _____ Longitude _____

Notes: _____

Village/Town/City _____ District _____ Province/State _____

Latitude _____ Longitude _____

Notes: _____

Village/Town/City _____ District _____ Province/State _____

Latitude _____ Longitude _____

Notes: _____

Village/Town/City _____ District _____ Province/State _____

Latitude _____ Longitude _____

Notes: _____

Village/Town/City _____ District _____ Province/State _____

Latitude _____ Longitude _____

Notes: _____

Village/Town/City _____ District _____ Province/State _____

Latitude _____ Longitude _____

Notes: _____

If there are more than six locations check here. ☐
Do not collect additional location information.

38. Why have you traveled? Select all that apply.
- ☐ work
- ☐ visit family
- ☐ moved
- ☐ religious reasons
- ☐ holiday/vacation
- ☐ go to hospital/seek medical care
- ☐ go to market
- ☐ other: _____

Participant ID_____
(For reference only)

Animal Contact Section

In this section, I'm going to ask you about the animals in your life since this time last year.

Since this time last year...

39. Has an animal lived as a pet in or near your dwelling? ○ yes ○ no

40. Have you handled live animals? ○ yes ○ no

41. Have you raised live animals? ○ yes ○ no

42. Have you shared a water source with animals for washing? ○ yes ○ no ○ don't know

43. Have you seen animal feces in or near food before you have eaten it? ○ yes ○ no

44. Have you eaten food after an animal has touched or damaged it? ○ yes ○ no ○ don't know
(Example: chew marks or scratches)

45. Do any animals come inside the dwelling where you live? ○ yes ○ no

46. Have you cooked or handled meat, organs or blood from a recently killed animal? ○ yes ○ no

47. Have you eaten raw or undercooked meat or organs or blood? ○ yes ○ no

48. Have you eaten an animal that you knew was not well/sick? ○ yes ○ no ○ don't know

49. Have you found a dead animal and collected it to eat or share? ○ yes ○ no

50. Have you found a dead animal and collected it to sell it? ○ yes ○ no

51. Have you been scratched or bitten by an animal? ○ yes ○ no

52. The last time you were scratched, bitten or cut yourself while butchering or slaughtering, what did you do?
Select all that apply.

- ○ let someone else take over
- ○ wash wound with soap and water
- ○ rinse wound with water
- ○ bandage wound
- ○ visit doctor
- ○ nothing - kept working
- ○ never butcher or slaughter

Animal Contact Section

53. Are there any risks associated with slaughtering or butchering when you have an open wound?

Interviewer: Do not read responses.

- ☐ no
- ☐ yes, but I don't know what they are
- ☐ yes, it can make you sick
- ☐ yes, it can poison you
- ☐ yes, it can infect you with a disease
- ☐ don't know
- ☐ other: _____

54. Have you slaughtered an animal? ☐ yes ☐ no

55. Have you hunted or trapped an animal? ☐ yes ☐ no
(If answered yes also ask hunter questionnaire)

56. Interviewer: Circle all headings where “yes” was answered in questions above. Then ask which animals/mammals for each “yes” category. Select all that apply.

	pet (39)	handled (40)	raised (41)	feces in or near food (43)	in house (45)	cooked/ handled (46)	eaten raw/ under cooked (47)	eaten sick (48)	found dead (49/50)	scratched/ bitten (51)	slaugh-tered (54)	hunted/ trapped (55)
rodents/shrews	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
bats	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
non-human primates	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
birds	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
carnivores	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
ungulates	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
pangolins	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
poultry	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
goats/sheep	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
camels	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
swine	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
cattle/buffalo	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
dogs	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
cats	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐

57. Are you worried about diseases or disease outbreaks in live animals in your local market? ☐ yes ☐ no

END OF MAIN QUESTIONNAIRE

Directions for selecting modules for the interview

Select module(s) identified in Question 2 (if any).

Conduct the following QUICK CHECKS.

1. Add the primary work activity module (Question 25)
2. Add the Temporary Settlement Module if Temporary Settlement is NOT selected in Question 2 and dwellings is NOT permanent (Question 15)
3. Add Hunter Module if hunter/trapper/fisher is selected in Question 25 or “yes” to Question 55.

Livelihood Module Table (based on response to Question 25)
Complete the modules that correspond with the livelihood chosen as follows:

extraction of minerals, gas, oil, timber – extractive industry module
crop production – crop production module
wildlife restaurant business – wildlife restaurant module
wild/exotic animal trade business – market and value chain module
rancher/farmer animal production business - animal production module
meat processing, slaughterhouse, abattoir - animal production module
zoo/sanctuary animal health care – zoos & sanctuaries module
hunter/trapper/fisher – hunter module
nurse, doctor, traditional healer, community health worker - hospital or clinic health professional module

If no additional modules are selected, the interview is complete.

Human Questionnaire Form ID Instructions

Enter the barcode number to the Human Questionnaire Form ID grid located at the top of each completed module.

The barcode is located at the bottom right hand corner of each page of the Human Questionnaire section. Use the number after the dash (-) and fill the grid with the numbers from top to bottom.

812-374986 173

Extractive Industry Module

EIDITH V 1.0

0 1 2 3 4 5 6 7 8 9
0 1 2 3 4 5 6 7 8 9
0 1 2 3 4 5 6 7 8 9
0 1 2 3 4 5 6 7 8 9
0 1 2 3 4 5 6 7 8 9
0 1 2 3 4 5 6 7 8 9

Add Human Questionnaire Form ID

Participant ID _____
(For reference only)

1. What type of work or industry is conducted here?
   Select one option.
   - ☐ underground mining (by shafts or tunnels)
   - ☐ open surface mining
   - ☐ hydraulic mining (high pressure water)
   - ☐ gathering, panning, or collecting
   - ☐ oil well/gas field
   - ☐ other: _____

2. What product(s) are extracted?
   Select one option.
   - ☐ coal
   - ☐ coltan
   - ☐ diamond or other gemstone
   - ☐ tin
   - ☐ gold/silver
   - ☐ lead
   - ☐ oil/gas
   - ☐ timber/plant
   - ☐ other: _____

3. Do you live on the work site?
   - ☐ yes
   - ☐ no

4. To the best of your knowledge, how many people work at this site?
   Select one option.
   - ☐ <10
   - ☐ 10-100
   - ☐ 101-1000
   - ☐ 1001-10,000
   - ☐ >10,000

5. How long have you worked at this site?
   Select one option.
   - ☐ <1 month
   - ☐ 1 month - 1 year
   - ☐ >1 year - 5 years
   - ☐ >5 years

6. Is there on-site food production?
   - ☐ yes
   - ☐ no

7. If yes, who pays for the cost to grow the food crops?
   - ☐ the company
   - ☐ the workers

8. Is there meat available for consumption?
   - ☐ yes
   - ☐ no

9. If yes, where does the meat come from?
Select all that apply.

- ☐ farmed onsite
- ☐ farmed and purchased from nearby local communities
- ☐ purchased from wholesale market
- ☐ locally caught/hunted
- ☐ bought frozen
- ☐ don't know

10. Is it possible to consume bushmeat/wild animal meat on or near the site? ☐ yes ☐ no

11. Is there a designated area for rubbish, including animal waste from slaughter/butcher and animal excrement? ☐ yes ☐ no

12. If yes, do people use the designated location for rubbish? ☐ yes ☐ no

13. Do any animals raid food supplies or destroy crops? ☐ yes ☐ no

14. If yes, which animals?
Select all that apply.

- ☐ rodents/shrews
- ☐ bats
- ☐ non-human primates
- ☐ birds
- ☐ carnivores
- ☐ ungulates
- ☐ pangolins
- ☐ poultry
- ☐ goats/sheep
- ☐ camels
- ☐ swine
- ☐ cattle/buffalo
- ☐ dogs
- ☐ cats

15. What is done to stop animals from raiding or destroying food supplies?
Select all that apply.

- ☐ barriers around fields
- ☐ barriers on individual trees
- ☐ fire
- ☐ poison
- ☐ traps
- ☐ shooting
- ☐ loud sounds
- ☐ natural predators
- ☐ flooding
- ☐ chasing animals out
- ☐ nothing

Crop Production Module

EIDITH V 1.0

0 1 2 3 4 5 6 7 8 9
0 1 2 3 4 5 6 7 8 9
0 1 2 3 4 5 6 7 8 9
0 1 2 3 4 5 6 7 8 9
0 1 2 3 4 5 6 7 8 9
0 1 2 3 4 5 6 7 8 9

Add Human Questionnaire Form ID

Participant ID _____
(For reference only)

1. Do you live on the work site?
- ☐ yes
- ☐ no

2. To the best of your knowledge, how many people work at this site?
Select one option.
- ☐ <10
- ☐ 10-100
- ☐ 101-1000
- ☐ 1001-10,000
- ☐ >10,000

3. How long have you worked at this site?
Select one option.
- ☐ <1 month
- ☐ 1 month - 1 year
- ☐ >1 year - 5 years
- ☐ >5 years

4. Which crops are at this site?
Select all that apply.
- ☐ coffee/tea/cocoa plants
- ☐ fruit/nut trees
- ☐ oil tree plantation
- ☐ oil seed crops
- ☐ dry grains
- ☐ sugar
- ☐ vegetable/fruit crops
- ☐ pulses/legume
- ☐ fiber
- ☐ forages
- ☐ cover crops
- ☐ fallow fields
- ☐ rubber

5. Does the farm use manure, guano or night soil to fertilizer the crops?
- ☐ yes
- ☐ no

6. If yes, which types?
Select all that apply.
- ☐ poultry
- ☐ camel
- ☐ swine
- ☐ cattle/buffalo
- ☐ bird guano
- ☐ bat guano
- ☐ night soil

7. Is there meat available for the consumption?
- ☐ yes
- ☐ no

8. If yes, where does the meat come from?
Select all that apply.
- ☐ farmed onsite
- ☐ farmed and purchased from nearby local communities
- ☐ purchased from wholesale market
- ☐ locally caught/hunted
- ☐ bought frozen
- ☐ don't know

9. Is it possible to consume bushmeat/wild animal meat on or near the site?
- ☐ yes
- ☐ no

10. Is there a designated area for rubbish, including animal waste from slaughter/butcher and animal excrement?
- ☐ yes
- ☐ no

11. If yes, do people use the designated location for rubbish?
- ☐ yes
- ☐ no

12. Do any animals raid food supplies or destroy crops?
- ☐ yes
- ☐ no

13. If yes, which animals? Select all that apply.
- ☐ rodents/shrews
- ☐ bats
- ☐ non-human primates
- ☐ birds
- ☐ carnivores
- ☐ ungulates
- ☐ pangolins
- ☐ poultry
- ☐ goats/sheep
- ☐ camels
- ☐ swine
- ☐ cattle/buffalo
- ☐ dogs
- ☐ cats

14. What is done to stop animals from raiding or destroying food supplies? Select all that apply.
- ☐ barriers around fields
- ☐ barriers on individual trees
- ☐ fire
- ☐ poison
- ☐ traps
- ☐ shooting
- ☐ loud sounds
- ☐ natural predators
- ☐ flooding
- ☐ chasing animals out
- ☐ nothing

Wildlife Restaurant Module

EIDITH V 1.0

0 1 2 3 4 5 6 7 8 9
0 1 2 3 4 5 6 7 8 9
0 1 2 3 4 5 6 7 8 9
0 1 2 3 4 5 6 7 8 9
0 1 2 3 4 5 6 7 8 9
0 1 2 3 4 5 6 7 8 9

Add Human Questionnaire Form ID

Participant ID _____
(For reference only)

1. Do you live on site?
   - ☐ yes
   - ☐ no

2. To the best of your knowledge, how many people work at this site?
   Select one option.
   - ☐ <10
   - ☐ 11-50
   - ☐ 51-100
   - ☐ 101-1000
   - ☐ >1001

3. How long have you worked here?
   Select one option.
   - ☐ <1 month
   - ☐ 1 month - 1 year
   - ☐ >1 year - 5 years
   - ☐ >5 years

4. What wild animals are on the menu today?
   Select all that apply.
   - ☐ rodents/shrews
   - ☐ bats
   - ☐ non-human primates
   - ☐ birds
   - ☐ carnivores
   - ☐ ungulates
   - ☐ pangolins

5. Since this time last year, have you had live animals on site?
   - ☐ yes
   - ☐ no

6. If yes, where do the animals come from?
   Select all that apply.
   - ☐ farmed and/or purchased from nearby local communities
   - ☐ wholesale live animal market
   - ☐ locally caught/hunted
   - ☐ other: _____

7. How do the live animals get to the restaurant?
   Select all that apply.
   - ☐ transport truck
   - ☐ car
   - ☐ motorbike
   - ☐ cart
   - ☐ delivered by hunter
   - ☐ public bus
   - ☐ brought in by customer
   - ☐ other: _____

8. How are live animals stored at night?
   Select all that apply.
   - ☐ multiple species in one enclosure
   - ☐ individual species in one enclosure
   - ☐ both multiple and individual species in enclosures

9. Are live animals slaughtered at the restaurant? ☐ yes ☐ no

10. Do you have special protective equipment (Example: shoes, masks, gloves) only worn at work? ☐ yes ☐ no

11. If yes, which protective equipment?
    Select all that apply.
    - ☐ shoes/boots
    - ☐ mask
    - ☐ clothes
    - ☐ gloves
    - ☐ gown/apron

12. When do you use protective equipment?
    Select all that apply.
    - ☐ handling animals
    - ☐ slaughter
    - ☐ butcher
    - ☐ always on at work
    - ☐ other: _____

13. Do you always use disinfectant to clean? ☐ yes ☐ no

14. If yes, do you always use disinfectants to clean the following:
    Select all that apply.
    - ☐ animal enclosures
    - ☐ food bins
    - ☐ counter tops
    - ☐ slaughtering/butchering equipment
    - ☐ hands
    - ☐ special protective equipment
    - ☐ floors

15. Is there a designated area for rubbish, including animal waste from slaughter/butcher and animal excrement? ☐ yes ☐ no

16. If yes, do people use the dedicated location for rubbish? ☐ yes ☐ no

17. Do any animals raid food or destroy supplies?
- ☐ yes
- ☐ no

18. If yes, which animals? Select all that apply.
- ☐ rodents/shrews
- ☐ bats
- ☐ non-human primates
- ☐ birds
- ☐ carnivores
- ☐ ungulates
- ☐ pangolins
- ☐ poultry
- ☐ goats/sheep
- ☐ camels
- ☐ swine
- ☐ cattle/buffalo
- ☐ dogs
- ☐ cats

19. What is done to stop animals from raiding or destroying food supplies? Select all that apply.
- ☐ barriers around fields
- ☐ barriers on individual trees
- ☐ fire
- ☐ poison
- ☐ traps
- ☐ shooting
- ☐ loud sounds
- ☐ natural predators
- ☐ flooding
- ☐ chasing animals out
- ☐ nothing

Market & Value Chain Module

EIDITH V 1.0

0 1 2 3 4 5 6 7 8 9
0 1 2 3 4 5 6 7 8 9
0 1 2 3 4 5 6 7 8 9
0 1 2 3 4 5 6 7 8 9
0 1 2 3 4 5 6 7 8 9
0 1 2 3 4 5 6 7 8 9

Add Human Questionnaire Form ID

Participant ID _____
(For reference only)

1. Do you live on the work site?
   - ☐ yes
   - ☐ no

2. To the best of your knowledge, how many people work at this site?
   Select one option.
   - ☐ <10
   - ☐ 10-50
   - ☐ 51-100
   - ☐ 101-1000
   - ☐ >1001

3. How long have you worked at this market?
   Select one option.
   - ☐ <1 month
   - ☐ 1 month - 1 year
   - ☐ >1 year - 5 years
   - ☐ >5 years

4. What animals are you selling today?
   Select all that apply.
   - ☐ rodents/shrews
   - ☐ bats
   - ☐ non-human primates
   - ☐ birds
   - ☐ carnivores
   - ☐ ungulates
   - ☐ pangolins
   - ☐ poultry
   - ☐ goats/sheep
   - ☐ camels
   - ☐ swine
   - ☐ cattle/buffalo
   - ☐ dogs
   - ☐ cats

5. Have you sold a live animal today?
   - ☐ yes
   - ☐ no

6. Who buys the live animals you sell?
   Select all that apply.
   - ☐ customer for home use
   - ☐ restaurants/hotels
   - ☐ customer who resells at another market
   - ☐ other: _____

7. Where do the animals come from?
   Select all that apply.
   - ☐ farmed and/or purchased from nearby local communities
   - ☐ wholesale live animal market
   - ☐ locally caught/hunted
   - ☐ other: _____

8. How do the live animals get to the market?
   Select all that apply.
   - ☐ transport truck
   - ☐ car
   - ☐ motorbike
   - ☐ cart
   - ☐ delivered by hunter
   - ☐ public bus
   - ☐ other: _____

9. How are live animals stored at night?
Select all that apply.

- ☐ multiple species in one enclosure
- ☐ individual species in one enclosure
- ☐ both multiple and individual species in enclosures

10. How long do you keep alive animals before you sell them? (in hours) _____

11. What do you do when an animal gets sick?
Select all that apply.

- ☐ kill the animal and dispose of the carcass
- ☐ kill the animal and sell it
- ☐ sell the live animal for discounted
- ☐ nothing different
- ☐ get veterinary care
- ☐ report to authorities
- ☐ other: _____

12. Do you have special protective equipment (Example: shoes, masks, gloves) only worn at work?

- ☐ yes
- ☐ no

13. If yes, which protective equipment?
Select all that apply.

- ☐ shoes/boots
- ☐ mask
- ☐ clothes
- ☐ gloves
- ☐ gown/apron

14. When do you use protective equipment?
Select all that apply.

- ☐ handling animals
- ☐ slaughter
- ☐ butcher
- ☐ always on at work
- ☐ other: _____

15. Is protective equipment used every time an animal is handled?

- ☐ yes
- ☐ no

16. When butchering animals, what happens to the refuse (blood, organs, skin, sinews, etc)?
Select all that apply.

- ☐ sell
- ☐ throw into refuse bin
- ☐ throw into the street/gutter
- ☐ take home to eat
- ☐ feed to animals
- ☐ no onsite slaughter

17. Do you always use disinfectant to clean?

- ☐ yes
- ☐ no

18. If yes, do you always use disinfectants to clean the following:
Select all that apply.

- ☐ animal enclosures
- ☐ food bins
- ☐ counter tops
- ☐ slaughtering/butchering equipment
- ☐ hands
- ☐ special protective equipment
- ☐ floors

19. How often are the animal enclosures cleaned?
Select one option.
- ○ daily
- ○ weekly
- ○ monthly
- ○ as needed
- ○ never

20. Is there a designated area for rubbish, including animal waste from slaughter/ butcher and animal excrement?
- ○ yes
- ○ no

21. If yes, do people use the dedicated area for rubbish?
- ○ yes
- ○ no

22. How often does the market close?
Select one option.
- ○ once per week
- ○ once every 2 weeks
- ○ once per month
- ○ as needed
- ○ only operates 1-5 days per week
- ○ never

23. Since this time last year, has an animal health official inspected your animals?
- ○ yes
- ○ no

24. Since this time last year, has anyone destroyed your animals because of infection or disease?
- ○ yes
- ○ no

25. If yes, which animals?
Select all that apply.
- ○ rodents/shrews
- ○ bats
- ○ non-human primates
- ○ birds
- ○ carnivores
- ○ ungulates
- ○ pangolins
- ○ poultry
- ○ goats/sheep
- ○ camels
- ○ swine
- ○ cattle/buffalo
- ○ dogs
- ○ cats

26. What is done to stop animals from raiding or destroying food supplies?
Select all that apply.
- ○ barriers around fields
- ○ barriers on individual trees
- ○ fire
- ○ poison
- ○ traps
- ○ shooting
- ○ loud sounds
- ○ natural predators
- ○ flooding
- ○ chasing animals out
- ○ nothing

Animal Production or Abattoir Module

EIDITH V 1.1

0 1 2 3 4 5 6 7 8 9
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0 1 2 3 4 5 6 7 8 9
0 1 2 3 4 5 6 7 8 9
0 1 2 3 4 5 6 7 8 9
0 1 2 3 4 5 6 7 8 9

Add Human Questionnaire Form ID

Participant ID _____
(For reference only)

1. Do you live on site?
   - ☐ yes
   - ☐ no

2. To the best of your knowledge, how many people work at this site?
   Select one option.
   - ☐ <10
   - ☐ 10-100
   - ☐ 101-1000
   - ☐ 1001-10,000
   - ☐ >10,000

3. How long have you worked here?
   Select one option.
   - ☐ <1 month
   - ☐ 1 month - 1 year
   - ☐ >1 year - 5 years
   - ☐ >5 years

4. Which animals are raised here?
   Select all that apply.
   - ☐ rodents/shrews
   - ☐ bats
   - ☐ non-human primates
   - ☐ birds
   - ☐ carnivores
   - ☐ ungulates
   - ☐ pangolins
   - ☐ poultry
   - ☐ goats/sheep
   - ☐ camels
   - ☐ swine
   - ☐ cattle/buffalo
   - ☐ dogs
   - ☐ cats

5. How are live animals stored at night?
   Select all that apply.
   - ☐ multiple species in one enclosure
   - ☐ individual species in one enclosure
   - ☐ both multiple and individual species in enclosures

6. Is there a quarantine period for new animals?
   - ☐ yes
   - ☐ no

7. Is there on-site food production?
   - ☐ yes
   - ☐ no

8. If yes, who pays for the cost to grow the food crops?
   - ☐ the company
   - ☐ the workers

9. Is there meat available for consumption?
   - ☐ yes
   - ☐ no

10. If yes, where does the meat come from?
Select all that apply.
- ☐ farmed onsite
- ☐ farmed and purchased from nearby local communities
- ☐ purchased from wholesale market
- ☐ locally caught/hunted
- ☐ bought frozen
- ☐ don't know

11. Is it possible to consume bushmeat/wild animal meat on or near the site?
- ☐ yes
- ☐ no

12. Do you have special protective equipment (Example: shoes, masks, gloves) only worn at work?
- ☐ yes
- ☐ no

13. If yes, which protective equipment?
Select all that apply.
- ☐ shoes/boots
- ☐ mask
- ☐ clothes
- ☐ gloves
- ☐ gown/apron

14. When do you use protective equipment?
Select all that apply.
- ☐ handling animals
- ☐ slaughter
- ☐ butcher
- ☐ always on at work
- ☐ other: _____

15. Do you always use disinfectant to clean?
- ☐ yes
- ☐ no

16. If yes, do you always use disinfectants to clean the following:
Select all that apply.
- ☐ animal enclosures
- ☐ food bins
- ☐ counter tops
- ☐ slaughtering/butchering equipment
- ☐ hands
- ☐ special protective equipment
- ☐ floors

17. How often are the animal enclosures cleaned?
Select one option.
- ☐ daily
- ☐ weekly
- ☐ monthly
- ☐ as needed
- ☐ never

18. When slaughtering/butchering animals, what happens to the viscara (blood, organs, skin, sinews, etc)?
Select all that apply.
- ☐ sell
- ☐ throw into refuse bin
- ☐ throw into the street/gutter
- ☐ take home to eat
- ☐ feed to animals
- ☐ no onsite slaughter

19. Is there a designated area for the disposal of animal waste?
- ☐ yes
- ☐ no

20. If yes, do people use the dedicated area for animal waste?
- ☐ yes
- ☐ no

21. Since this time last year, have the animals received veterinary care?
- ☐ yes
- ☐ no

22. Since this time last year, has an animal health official inspected your animals?
- ☐ yes
- ☐ no

23. What do you do when an animal gets sick? Select all that apply.
- ☐ kill the animal and dispose of the carcass
- ☐ kill the animal and sell it
- ☐ sell the live animal for discounted
- ☐ nothing different
- ☐ get veterinary care
- ☐ report to authorities
- ☐ other: _____

24. Since this time last year, has anyone quarantined or destroyed your animals because of infection or disease?
- ☐ yes
- ☐ no

25. If yes, which animals? Select all that apply.
- ☐ rodents/shrews
- ☐ bats
- ☐ non-human primates
- ☐ birds
- ☐ carnivores
- ☐ ungulates
- ☐ pangolins
- ☐ poultry
- ☐ goats/sheep
- ☐ camels
- ☐ swine
- ☐ cattle/buffalo
- ☐ dogs
- ☐ cats

26. Since this time last year, has there been a disease outbreak among any raised animals or livestock?
- ☐ yes
- ☐ no

27. If yes, which animals? (Indicate the percentage that died during the outbreak.) Select all that apply.

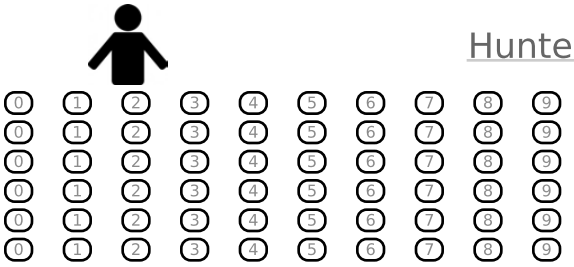
	1-25%	26-50%	51-75%	76-100%	don't know
rodents/shrews	☐	☐	☐	☐	☐
bats	☐	☐	☐	☐	☐
non-human primates	☐	☐	☐	☐	☐
birds	☐	☐	☐	☐	☐
carnivores	☐	☐	☐	☐	☐
ungulates	☐	☐	☐	☐	☐
pangolins	☐	☐	☐	☐	☐
poultry	☐	☐	☐	☐	☐
goats/sheep	☐	☐	☐	☐	☐
camels	☐	☐	☐	☐	☐
swine	☐	☐	☐	☐	☐
cattle/buffalo	☐	☐	☐	☐	☐
dogs	☐	☐	☐	☐	☐
cats	☐	☐	☐	☐	☐

28. Do any animals raid or destroy food supplies?
- ☐ yes
- ☐ no

29. If yes, what animals? Select all that apply.
- ☐ rodents/shrews
- ☐ bats
- ☐ non-human primates
- ☐ birds
- ☐ carnivores
- ☐ ungulates
- ☐ pangolins
- ☐ poultry
- ☐ goats/sheep
- ☐ camels
- ☐ swine
- ☐ cattle/buffalo
- ☐ dogs
- ☐ cats

30. What is done to stop animals from raiding or destroying food supplies? Select all that apply.
- ☐ barriers around fields
- ☐ barriers on individual trees
- ☐ fire
- ☐ poison
- ☐ traps
- ☐ shooting
- ☐ loud sounds
- ☐ natural predators
- ☐ flooding
- ☐ chasing animals out
- ☐ nothing

Notes



Hunter Module

EIDITH V 1.1

Add Human Questionnaire Form ID

Participant ID _____
(For reference only)

1. What animals have you hunted since this time last year?
Select all that apply.

- ☐ rodents/shrews
- ☐ bats
- ☐ non-human primates
- ☐ birds
- ☐ carnivores
- ☐ ungulates
- ☐ pangolins

2. Since this time last year, what methods have you used to hunt/trap animals?
Select all that apply.

- ☐ snare
- ☐ bow
- ☐ hands
- ☐ gun
- ☐ machete
- ☐ knife
- ☐ net
- ☐ cage
- ☐ trap
- ☐ other: _____

3. What is the purpose of your trapping or hunting?
Select all that apply.

	for consumption at home	for use of animal products at home	for sale for consump -tion	for sale alive at market	for sale of animal products	live trapping of nuisance animals for translocation	culling of nuisance animals
rodents/shrews	☐	☐	☐	☐	☐	☐	☐
bats	☐	☐	☐	☐	☐	☐	☐
non-human primates	☐	☐	☐	☐	☐	☐	☐
birds	☐	☐	☐	☐	☐	☐	☐
carnivores	☐	☐	☐	☐	☐	☐	☐
ungulates	☐	☐	☐	☐	☐	☐	☐
pangolins	☐	☐	☐	☐	☐	☐	☐

Since this time last year, when you hunt or trap:

4. Are you exposed to blood? ☐ yes ☐ no

5. Have you been scratched or bitten? ☐ yes ☐ no

6. Since this time last year, have you seen an outbreak of dead wild animals? ☐ yes ☐ no

7. If yes, which wild animals?
Select all that apply.

- ☐ rodents/shrews
- ☐ bats
- ☐ non-human primates
- ☐ birds
- ☐ carnivores
- ☐ ungulates
- ☐ pangolins

8. What do you do when you find an animal dead (not in a trap or shot by another hunter)? Select all that apply.
   - ☐ touch it to see if it is still fresh
   - ☐ butcher in the forest
   - ☐ smoke or cook in the forest
   - ☐ take home to prepare
   - ☐ bury it
   - ☐ report it to authorities
   - ☐ take it to sell it
   - ☐ nothing
   - ☐ other: _____

9. How do you transport a dead animal, if you take it? Select all that apply.
   - ☐ not wrapped
   - ☐ wrapped in leaves or other natural material
   - ☐ wrapped in plastic
   - ☐ in a bag
   - ☐ in a basket

10. Do you have special protective equipment (Example: shoes, masks, gloves)?
    - ☐ yes
    - ☐ no

11. If yes, which protective equipment? Select all that apply.
    - ☐ shoes/boots
    - ☐ mask
    - ☐ clothes
    - ☐ gloves
    - ☐ gown/apron

12. When do you use protective equipment? Select all that apply.
    - ☐ handling animals
    - ☐ slaughter
    - ☐ butcher
    - ☐ always on at work
    - ☐ other: _____

Temporary Settlement Module

EIDITH V 1.0

Add Human Questionnaire Form ID

Participant ID _____

(For reference only)

1. What is your nationality? _____

2. How long have you lived at this settlement?
Select one option.
- ☐ <1 week
- ☐ 1-4 weeks
- ☐ 1-5 months
- ☐ 6-11 months
- ☐ > 1 year
- ☐ entire life

3. To the best of your knowledge, how many people live at this site?
Select one option.
- ☐ <10
- ☐ 10-100
- ☐ 101-1000
- ☐ 1001-10,000
- ☐ >10,000

4. Are all the people living here from this country?
- ☐ yes
- ☐ no

5. Why did you settle here?
Select all that apply.
- ☐ job/work (voluntary relocation)
- ☐ family (voluntary relocation)
- ☐ marriage (voluntary relocation)
- ☐ conflict (forced relocation)
- ☐ dispossession of previous home (forced relocation)
- ☐ natural disaster (forced relocation)

6. Is there on-site food production?
- ☐ yes
- ☐ no

7. Is there meat available for consumption?
- ☐ yes
- ☐ no

8. If yes, where does the meat come from?
Select all that apply.
- ☐ farmed onsite
- ☐ farmed and purchased from nearby local communities
- ☐ purchased from wholesale market
- ☐ locally caught/hunted
- ☐ bought frozen
- ☐ don't know

9. Is it possible to consume bushmeat/wild animal meat on or near the site?
- ☐ yes
- ☐ no

10. Which animals are available for consumption?
Select all that apply.
- ☐ rodents/shrews
- ☐ bats
- ☐ non-human primates
- ☐ birds
- ☐ carnivores
- ☐ ungulates
- ☐ pangolins
- ☐ poultry
- ☐ goats/sheep
- ☐ camels
- ☐ swine
- ☐ cattle/buffalo
- ☐ dogs
- ☐ cats

11. Is there a designated area for rubbish, including animal waste from slaughter/butcher and animal excrement?
- ☐ yes
- ☐ no

12. If yes, do people use the designated location for rubbish?
- ☐ yes
- ☐ no

13. Do any animals raid food supplies or destroy crops?
- ☐ yes
- ☐ no

14. If yes, which animals?
Select all that apply.
- ☐ rodents/shrews
- ☐ bats
- ☐ non-human primates
- ☐ birds
- ☐ carnivores
- ☐ ungulates
- ☐ pangolins
- ☐ poultry
- ☐ goats/sheep
- ☐ camels
- ☐ swine
- ☐ cattle/buffalo
- ☐ dogs
- ☐ cats

15. What is done to stop animals from raiding or destroying food supplies?
Select all that apply.
- ☐ barriers around fields
- ☐ barriers on individual trees
- ☐ fire
- ☐ poison
- ☐ traps
- ☐ shooting
- ☐ loud sounds
- ☐ natural predators
- ☐ flooding
- ☐ chasing animals out
- ☐ nothing

Tourism Module

EIDITH
V 1.0

Add Human Questionnaire Form ID

Participant ID _____
(For reference only)

1. What is your nationality? _____

2. List all the countries you have visited in the past month.

_____ _____

_____ _____

_____ _____

3. How long have you been at the current location?
Select one option.

- ☐ 1 day
- ☐ 2-7 days
- ☐ 8-14 days
- ☐ > 2 weeks

4. Which activities did you undertake on this trip?
Select all that apply.

- ☐ wildlife tourism
- ☐ cave tourism
- ☐ camping
- ☐ hunting
- ☐ trekking in natural areas
- ☐ religious pilgrimage
- ☐ visiting wildlife market
- ☐ other: _____

5. What animals have you eaten during this trip?
Select all that apply.

- ☐ rodents/shrews
- ☐ bats
- ☐ non-human primates
- ☐ birds
- ☐ carnivores
- ☐ ungulates
- ☐ pangolins
- ☐ poultry
- ☐ goats/sheep
- ☐ camels
- ☐ swine
- ☐ cattle/buffalo
- ☐ dogs
- ☐ cats
- ☐ unknown
- ☐ none

Zoos & Sanctuaries Module

EIDITH V 1.0

Add Human Questionnaire Form ID

Participant ID _____
(For reference only)

1. Do you live on site?
   - ☐ yes
   - ☐ no

2. To the best of your knowledge, how many people work at this site?
   Select one option.
   - ☐ <10
   - ☐ 11-50
   - ☐ 51-100
   - ☐ 101-1000
   - ☐ >1001

3. How long have you worked here?
   Select one option.
   - ☐ <1 month
   - ☐ 1 month - 1 year
   - ☐ >1 year - 5 years
   - ☐ >5 years

4. What species do you work with?
   Select all that apply.
   - ☐ rodents/shrews
   - ☐ bats
   - ☐ non-human primates
   - ☐ birds
   - ☐ carnivores
   - ☐ ungulates
   - ☐ pangolins
   - ☐ poultry
   - ☐ goats/sheep
   - ☐ camels
   - ☐ swine
   - ☐ cattle/buffalo
   - ☐ dogs
   - ☐ cats

5. Do you have special protective equipment (Example: shoes, masks, gloves) only worn at work?
   - ☐ yes
   - ☐ no

6. If yes, which protective equipment?
   Select all that apply.
   - ☐ shoes/boots
   - ☐ mask
   - ☐ clothes
   - ☐ gloves
   - ☐ gown/apron

7. When do you use protective equipment?
   Select all that apply.
   - ☐ handling animals
   - ☐ slaughter
   - ☐ butcher
   - ☐ always on at work
   - ☐ other: _____

8. Do you always use disinfectant to clean?
- ○ yes
- ○ no

9. If yes, do you always use disinfectants to clean the following:
Select all that apply.
- ○ animal enclosures
- ○ food bins
- ○ counter tops
- ○ slaughtering/butchering equipment
- ○ hands
- ○ special protective equipment
- ○ floors

10. How often are the animal enclosures cleaned?
Select one option.
- ○ daily
- ○ weekly
- ○ monthly
- ○ as needed
- ○ never

11. Is there a designated area for the disposal of animal waste?
- ○ yes
- ○ no

12. If yes, do people use the dedicated area for animal waste?
- ○ yes
- ○ no

13. Is there a quarantine period for new animals?
- ○ yes
- ○ no

14. Is there a preventative medicine program for the animals?
- ○ yes
- ○ no

15. Do any animals raid food or destroy supplies?
- ○ yes
- ○ no

16. If yes, which animals?
Select all that apply.
- ○ rodents/shrews
- ○ bats
- ○ non-human primates
- ○ birds
- ○ carnivores
- ○ ungulates
- ○ pangolins
- ○ poultry
- ○ goats/sheep
- ○ camels
- ○ swine
- ○ cattle/buffalo
- ○ dogs
- ○ cats

17. What is done to stop animals from raiding or destroying food supplies?
Select all that apply.
- ○ barriers around fields
- ○ barriers on individual trees
- ○ fire
- ○ poison
- ○ traps
- ○ shooting
- ○ loud sounds
- ○ natural predators
- ○ flooding
- ○ chasing animals out
- ○ nothing

EIDITH V 1.0

Add Human Questionnaire Form ID

Participant ID _____
(For reference only)

1. What are your human health activities?
   - ☐ hospital or clinic administrator
   - ☐ hospital or clinic custodial worker
   - ☐ hospital or clinic clinician or nurse (medicine specialty)
   - ☐ hospital or clinic clinician or nurse (surgery specialty)
   - ☐ mobile clinic
   - ☐ traditional healer
   - ☐ dispensary or pharmacy

2. Do you have special protective equipment (Example: shoes, masks, gloves) only worn at work?
   - ☐ yes
   - ☐ no

3. If yes, which protective equipment?
   Select all that apply.
   - ☐ shoes/boots
   - ☐ mask
   - ☐ clothes
   - ☐ gloves
   - ☐ gown/apron

4. Is protective equipment used every time you examine or collect specimens from a patient?
   - ☐ yes
   - ☐ no

5. Is the protective equipment cleaned, sterilized or discarded after each use?
   - ☐ yes
   - ☐ no

6. Do you always use disinfectants to clean?
   - ☐ yes
   - ☐ no

EIDITH V 1.1

Add Human Questionnaire Form ID

Participant ID _____
(For reference only)

1. Body temperature at time of sampling (celsius): _____

2. For how many days have you had a fever? _____

3. Date of symptom onset _____

4. Signs and symptoms of present illness.
Select all that apply.

- ☐ abdominal pain
- ☐ altered consciousness
- ☐ any movement in stomach
- ☐ asphyxiate
- ☐ bleeding
- ☐ chills
- ☐ cold
- ☐ convulsions
- ☐ cough
- ☐ dark urine
- ☐ diarrhea
- ☐ dizziness
- ☐ eye pain
- ☐ fever
- ☐ headache
- ☐ jaundice
- ☐ joint pain
- ☐ malaise
- ☐ muscle pain
- ☐ no appetite
- ☐ rash
- ☐ sore throat
- ☐ stiff neck
- ☐ vomiting
- ☐ other: _____
- ☐ Do not use. For future use.

5. Date of hospitalization for present illness _____

6. Date of specimen collection _____

7. Antiviral use for present illness at the time of specimen collection? ☐ yes ☐ no

8. If yes, what type of antiviral use? _____

9. Presence of chronic pre-existing medical illnesses:
Select all that apply.

- ☐ chronic respiratory disease
- ☐ asthma
- ☐ diabetes
- ☐ chronic cardiac disease
- ☐ chronic neurological disease
- ☐ chronic neuromuscular disease
- ☐ hematological disorders
- ☐ immunodeficiency disorders
- ☐ HIV or AIDS

Women Only

10. Pregnancy status ☐ yes ☐ no

11. If yes, how many months pregnant? _____

Appendix D – PREDICT Hospital Intake Form

Hospital Intake Form

All relevant laboratory test results will be given to the doctor who is responsible for the patient. Patient data will be anonymous at the laboratory.

A. General Patient Information

Hospital Name _____ Hospital address (City) _____

Patient Name: _____

Patient Address (Street name and House number) : _____

Age : _____years _____month sex : € male € female Pregnant € No € Yes

Body Temperature at time of sampling (in C^{O}) _____

Date of onset: _____ (dd/mm/yy) Admission date _____ (dd/mm/yy)

Symptom	Current condition			Details	Symptom	Current condition			Details	Symptom	Current condition			Details
	Yes	No	unclear			Yes	No	unclear			Yes	No	unclear	
Fever				…….. ^{O}C	Malaise					Stiff neck				
Chills					No appetite					convulsions				
Headache					Asphyxiate					Eye Pain				
Cough					Diarrhea					Joint pain				
Dizziness					Cold					Muscle pain				
Vomiting					Bleeding					Abdominal pain				
SoreThroat					Dark urine					Any movement in stomach				
Rash					Jaundice					Altered Consciousness				
Other														

Occupation: _____

Travel history (past 2 mo) € None € Yes, to _____ When? _____

Animal contact (indicate yes/no) €Livestock _____ € Birds _____ €Bats ____ € Rodents _____ €Monkeys/Primates € Other animal (please specify) _____ € if yes for any, please explain type of contact (€ hunt, € butcher, € clean, € eat, € raise/farm, € transport/handle)

_____

Animal contact at €work or € in daily activities? € If Yes, When?_____

Other symptom in family member or member of household? € No € Yes € If Yes, whom and what symptom _____

Current diagnosis _____

Antiviral use at time of specimen collection € None € Yes, what _____

B. Type of Specimen

Identity number used in Hospital : _____ assessed by (Initial):_____

€Whole blood /serum / plasma (circle one)	1st Sample collection date _____	Code specimen: _____
€Whole blood / serum / plasma (circle one)	2nd Sample collection date _____	Code specimen: _____
€ Swab nasal / throat / rectal (circle one)	Sample collection date _____	Code specimen: _____
€ Sputum	Sample collection date _____	Code specimen: _____
€ CSF	Sample collection date _____	Code specimen: _____
€Other _____	Sample collection date _____	Code specimen: _____

Laboratory Test Request Form

B. Previous Laboratory tests and results:

€ Influenza virus RT-PCR / virus culture / serology (circle one) Test Results: _____

€ Dengue virus RT-PCR / virus culture / serology (circle one) Test Results: _____

€ Chikungunya virus RT-PCR / virus culture / serology (circle one) Test Results: _____

€ Malaria microscopy / rapid diagnostic test (Binax NOW) / serology (circle one) Test Results: _____

€ other (please specify) _____ Test Results: _____

€ other (please specify) _____ Test Results: _____

€ other (please specify) _____ Test Results: _____

Requested by (name): _____ Contact Number: _____

6.2 INFORMATION MANAGEMENT – NEW EIDITH DATA COLLECTION TOOLS AND MOBILE APPLICATIONS

PREDICT works closely with host governments and partners to interpret and share information through systems designed to protect and ensure data quality and accuracy. PREDICT data are managed in a purposefully-designed internal information management system (EIDITH), in which all data undergo a rigorous quality control process. Diagnostic test results are interpreted in light of all available scientific literature by PREDICT virologists. After interpretation, results are provided to host governments for examination, to inform policy, and for approval for public release through the PREDICT data site powered by our partner HealthMap (http://data.predict.global). This open access platform allows users to visualize PREDICT data along with disease events worldwide.

Surveillance Data Collection Tools. This year, PREDICT's information management team worked together across all project operational teams to develop new data collection tools and applications for surveillance sites and events, for animal sample data, and for behavioral risk data captured during interviews with people at high-risk sites for animal-human contact. These tools are available electronically to all project staff through the PREDICT's Emerging Infectious Disease Information and Technology Hub (EIDITH – eidith.org), as well as through a novel optical mark recognition system (bubble forms) enabling the digitization of data collected on paper-based forms in the field.

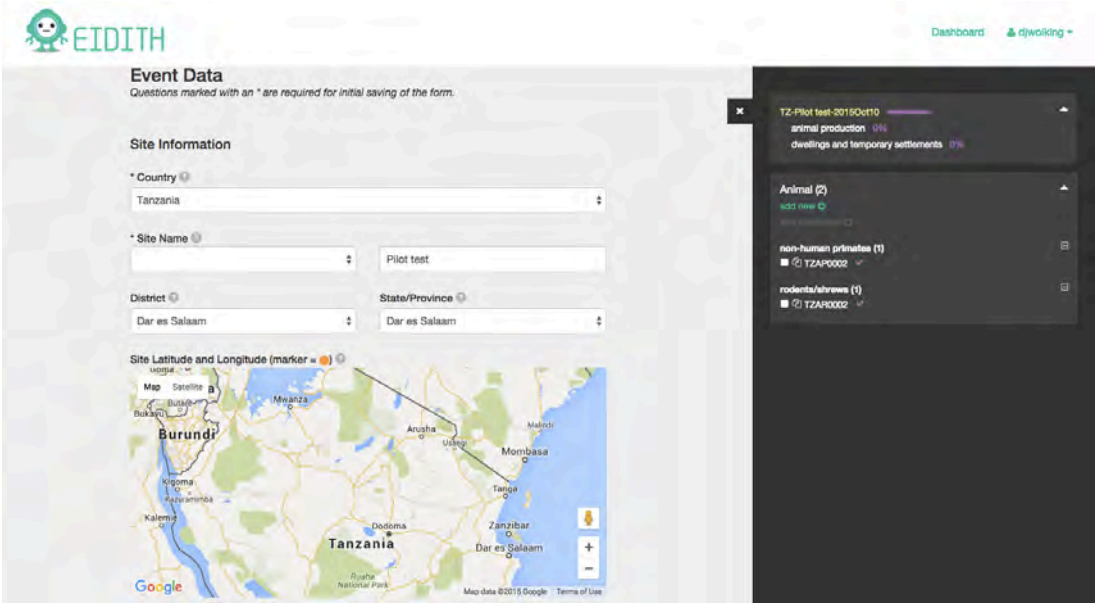


Photo 1. Screenshot of the EIDITH Site and Event application now in use and available as a mobile app for all PREDICT country teams.

Training Data Capture Tools. Also this year, to enable better tracking of training events, PREDICT designed training data collection tools and an electronic platform for internal project use in EIDITH to capture training data and generate reports. This platform (*described in depth in Section 1 under Objective 4*) equips

PREDICT leadership with the potential to monitor training status in real time, to ensure all key personnel are up to date on essential skills and techniques, and to support compliance monitoring of all project activities. The application is available electronically to PREDICT staff via “training.eidith.org” or through EIDITH’s newly developed optical mark recognition system (bubble forms) for teams requiring paper-based forms for data capture in the field.

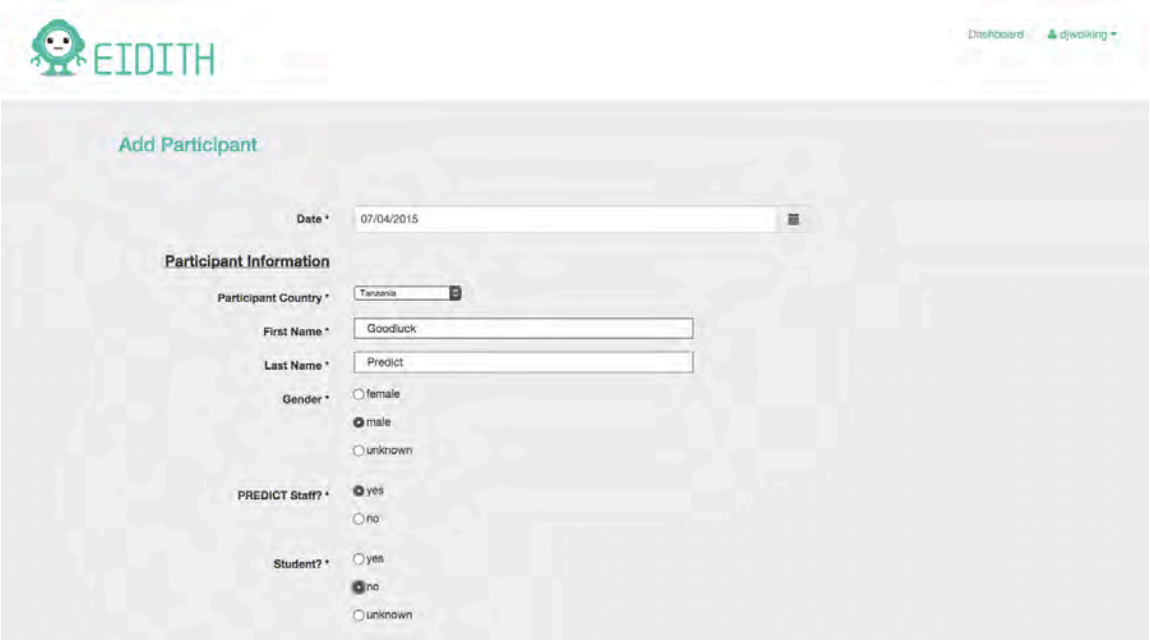


Photo 1. Screenshot of the EIDITH Training Application now available to all PREDICT teams for the recording and submission of training event and participant data.

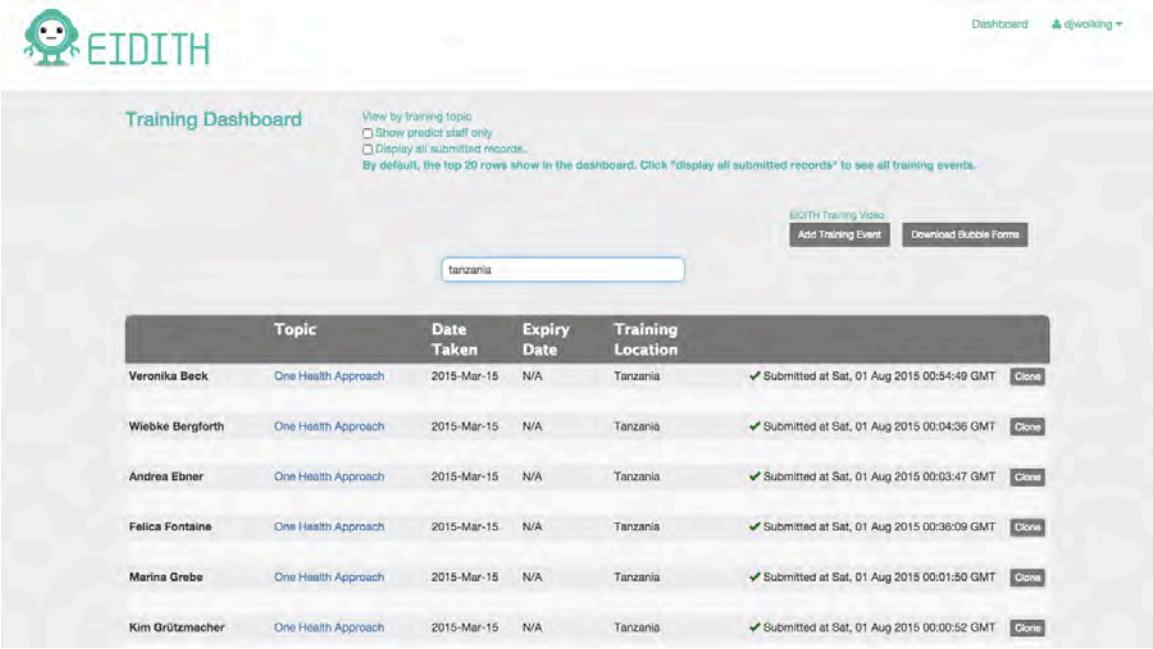


Photo 2. Screenshot of the EIDITH Training Dashboard enabling Country Coordinators and regional and global leads to monitor the status of trainings across the project.

Site and Event Characterization Form

EIDITH
V 1.3

Site Section

1. Site Name _____

2. Country _____ 3. State/Province _____

4. District _____

5. Site Latitude _____ Site Longitude _____
Preferred method - decimal degress

Event Section

6. Recorder _____

7. Recorder's Organization
- ○ EcoHealth Alliance
- ○ Metabiota
- ○ Smithsonian Conservation Biology Institute
- ○ UC Davis
- ○ Wildlife Conservation Society

8. Date of Event _____
(eg. 2015-Apr-01)

9. Duration of Event (in days)
○ 1 ○ 2 ○ 3 ○ 4 ○ 5 ○ 6 ○ 7 ○ 8 ○ 9 ○ 10
○ 11 ○ 12 ○ 13 ○ 14 ○ 15 ○ 16 ○ 17 ○ 18 ○ 19 ○ 20

10. Where are you sampling within the site for this event?

Latitude _____ Longitude _____
Preferred method - decimal degress

11. Which one of these 4 options best describes the human density and impact at this event site? Select one option.
- ○ urban
- ○ peri-urban
- ○ rural
- ○ low disturbance

12. What is the target animal-human disease transmission interface for this event? * Select all that apply.

- ○ animal production
- ○ crop production
- ○ dwellings and temporary settlements
- ○ extractive industry
- ○ market and value chain
- ○ natural area
- ○ wildlife restaurant
- ○ zoos and sanctuaries
- ○ human hospital
- ○ outbreak response

*** Be sure to download modules for all selected interfaces**

13. Does a veterinarian care for animals at the event/site?
- ○ yes
- ○ no

14. To the best of your knowledge, what is the estimated size of the area for this event in square meters? Select one option.

- ☐ small <650 sq. m.
- ☐ medium 650 - 3500 sq. m.
- ☐ large 3500 – 7000 sq. m.
- ☐ extra large >7000 sq. m.

15. To the best of your knowledge, what is the estimated number of humans and animals (live or dead) within 0.5 km in any direction? Select one option per row.

	none present	1-10	11-100	101-1000	>1000
humans	☐	☐	☐	☐	☐
rodents/shrews	☐	☐	☐	☐	☐
bats	☐	☐	☐	☐	☐
non-human primates	☐	☐	☐	☐	☐
birds	☐	☐	☐	☐	☐
carnivores	☐	☐	☐	☐	☐
ungulates	☐	☐	☐	☐	☐
poultry	☐	☐	☐	☐	☐
goats/sheep	☐	☐	☐	☐	☐
camels	☐	☐	☐	☐	☐
swine	☐	☐	☐	☐	☐
cattle/buffalo	☐	☐	☐	☐	☐
dogs	☐	☐	☐	☐	☐
cats	☐	☐	☐	☐	☐

16. Is water shared between humans and animals for...
Select one option per row.

	yes	no	unknown
drinking	☐	☐	☐
bathing/cleaning	☐	☐	☐

17. Are the toilets, latrines or other public facilities available for people at this site...
Select all that apply.

- ☐ well maintained
- ☐ not maintained
- ☐ used
- ☐ not used
- ☐ none observed

18. Where do people at this site get their drinking water? Select all that apply.

- ☐ fully unprotected: pond, uncovered well
- ☐ rainwater harvesting, water trucking
- ☐ fully protected: water network with taps, covered well
- ☐ none observed

19. How long is the average trip to the drinking water sources? Select one option.

- ☐ <5 minutes walking
- ☐ 5-30 minutes walking
- ☐ >30 minutes walking

20. What types of insect vectors are observed at the site?
Select all that apply.

- ☐ mosquito
- ☐ sand fly
- ☐ tsetse fly
- ☐ tick
- ☐ none observed
- ☐ other: _____

21. Are vector control measures used at the site?

- ☐ yes
- ☐ no

Animal Production Module

EIDITH

V 1.3

Add Site and Event Form ID:

Site name and date:

_____

(For reference only)

0 1 2 3 4 5 6 7 8 9
0 1 2 3 4 5 6 7 8 9
0 1 2 3 4 5 6 7 8 9
0 1 2 3 4 5 6 7 8 9
0 1 2 3 4 5 6 7 8 9
0 1 2 3 4 5 6 7 8 9

1. What is the type of production system? Select one option.
   - ○ family owned
   - ○ corporate
   - ○ government

2. What is the number and density of animals in production at this facility? Select one option per row. If the answer in the number section is NOT "none", then write in the number for each enclosure question.

	none	1-10	11-100	101-1000	>1000	number of enclosures	average number of animals per enclosure	average size of enclosure (square meters)	average number of freeranging or tethered animals
rodents/shrews	○	○	○	○	○				
bats	○	○	○	○	○				
non-human primates	○	○	○	○	○				
birds	○	○	○	○	○				
carnivores	○	○	○	○	○				
ungulates	○	○	○	○	○				
poultry	○	○	○	○	○				
goats/sheep	○	○	○	○	○				
camels	○	○	○	○	○				
swine	○	○	○	○	○				
cattle/buffalo	○	○	○	○	○				
dogs	○	○	○	○	○				
cats	○	○	○	○	○				

3. For each taxonomic group, what is the purpose of animal production? Select all that apply for each row.

	for food	for resale of animals	for sale of animal products	for breeding	not observed
rodents/shrews	☐	☐	☐	☐	☐
bats	☐	☐	☐	☐	☐
non-human primates	☐	☐	☐	☐	☐
birds	☐	☐	☐	☐	☐
carnivores	☐	☐	☐	☐	☐
ungulates	☐	☐	☐	☐	☐
poultry	☐	☐	☐	☐	☐
goats/sheep	☐	☐	☐	☐	☐
camels	☐	☐	☐	☐	☐
swine	☐	☐	☐	☐	☐
cattle/buffalo	☐	☐	☐	☐	☐
dogs	☐	☐	☐	☐	☐
cats	☐	☐	☐	☐	☐

4. Are there multiple taxa in one holding area or cage? ☐ yes ☐ no

5. Are wild animals and domesticated animals held together in one holding area or cage? ☐ yes ☐ no

6. For each taxonomic group <u>in production</u>, what is the type of containment for the enclosure/housing?
Select all that apply for each row.

	free-range (open range)	tethered grazing outdoor	fenced outdoor enclosure	outdoor cage	indoor enclosure in fully enclosed facility	not observed
rodents/shrews	☐	☐	☐	☐	☐	☐
bats	☐	☐	☐	☐	☐	☐
non-human primates	☐	☐	☐	☐	☐	☐
birds	☐	☐	☐	☐	☐	☐
carnivores	☐	☐	☐	☐	☐	☐
ungulates	☐	☐	☐	☐	☐	☐
poultry	☐	☐	☐	☐	☐	☐
goats/sheep	☐	☐	☐	☐	☐	☐
camels	☐	☐	☐	☐	☐	☐
swine	☐	☐	☐	☐	☐	☐
cattle/buffalo	☐	☐	☐	☐	☐	☐
dogs	☐	☐	☐	☐	☐	☐
cats	☐	☐	☐	☐	☐	☐

7. Are animals slaughtered and butchered on-site?
- ☐ yes
- ☐ no

8. If yes above, is there a designated area for slaughtering and butchering?
- ☐ yes
- ☐ no

9. What type of animal waste is present at the site/event? Select all that apply.
- ☐ feces
- ☐ soiled bedding (urine and feces)
- ☐ animal tissue and/or blood
- ☐ none

10. What types of biosecurity measures are practiced at the facility? Select all that apply.
- ☐ hand washing facilities
- ☐ showering facilities
- ☐ footbaths
- ☐ gloves for personnel
- ☐ protective clothing and footwear for personnel and other visitors
- ☐ washing and disinfecting crates or other equipment entering the facility
- ☐ allowing only essential personnel to enter animal buildings
- ☐ quarantine of new and/or diseased animals
- ☐ removal and disposal of dead animals
- ☐ no biosecurity observed

11. Are there animals living in the human dwellings?
- ☐ yes
- ☐ no

Crop Production Module

EIDITH V 1.3

Add Site and Event Form ID: ⓪ ① ② ③ ④ ⑤ ⑥ ⑦ ⑧ ⑨

Site name and date: _____

(For reference only)

1. Which crops are planted on the site? Select all that apply.

- ☐ coffee/tea/cocoa plants
- ☐ fruit/nut trees
- ☐ oil tree plantation
- ☐ oil seed crops
- ☐ dry grains
- ☐ sugar
- ☐ vegetable/fruit crops
- ☐ pulses/legume
- ☐ fiber
- ☐ forages
- ☐ cover crops
- ☐ fallow fields
- ☐ rubber

2. What type of crop production system is it? Select one option.

- ☐ family owned
- ☐ corporate
- ☐ government

3. What is the purpose of growing crops on site? Select one option for each crop that exists at the site.

	individual household	village level	large scale production	no crop
coffee/tea/cocoa plants	☐	☐	☐	☐
fruit/nut trees	☐	☐	☐	☐
oil tree plantation	☐	☐	☐	☐
oil seed crops	☐	☐	☐	☐
dry grains	☐	☐	☐	☐
vegetable/fruit crops	☐	☐	☐	☐
sugar	☐	☐	☐	☐
pulses/legume	☐	☐	☐	☐
fiber	☐	☐	☐	☐
forages	☐	☐	☐	☐
cover crops	☐	☐	☐	☐
fallow fields	☐	☐	☐	☐
rubber	☐	☐	☐	☐

4. What are the observed practices or signs of practices used for preventing crop raiding and pest damage? Select all that apply.

- ☐ barriers around fields
- ☐ barriers on individual trees
- ☐ fire
- ☐ poison
- ☐ traps
- ☐ shooting
- ☐ loud sounds
- ☐ natural predators
- ☐ flooding
- ☐ chasing animals out
- ☐ none

5. What types of fertilizers are used on the crops? Select all that apply.

- ☐ chemical fertilizer
- ☐ animal manure or guano
- ☐ none

6. What is the source of manure fertilizer? Select all that apply.

	composted or dried manure	fresh manure	none
poultry	☐	☐	☐
camels	☐	☐	☐
swine	☐	☐	☐
cattle/buffalo	☐	☐	☐
bat guano	☐	☐	☐
bird guano	☐	☐	☐

7. Are crops stored at this site after harvest?
   - ○ yes
   - ○ no
   - ○ unknown

8. If yes above, what is the storage location of the harvested crops?
   Select all that apply for each crop that exists at the site.

	inside dwellings	storage sacks outside	improved silo granary storage	not observed	other (fill in box)	
coffee/tea/cocoa plants	○	○	○	○	○	
fruit/nut trees	○	○	○	○	○	
oil tree plantation	○	○	○	○	○	
oil seed crops	○	○	○	○	○	
dry grains	○	○	○	○	○	
sugar	○	○	○	○	○	
vegetable/fruit crops	○	○	○	○	○	
pulses/legume	○	○	○	○	○	
fiber	○	○	○	○	○	
forages	○	○	○	○	○	
rubber	○	○	○	○	○	

9. Is there evidence (direct observation, signs, scat, tracks) of animals feeding on or visiting crop fields or stored crops?
   Select all that apply.

	in crop fields	in stored crops	none
rodents/shrews	○	○	○
bats	○	○	○
non-human primates	○	○	○
birds	○	○	○
carnivores	○	○	○
ungulates	○	○	○
elephants	○	○	○
pangolins	○	○	○
poultry	○	○	○
goats/sheep	○	○	○
camels	○	○	○
swine	○	○	○
cattle/buffalo	○	○	○
dogs	○	○	○
cats	○	○	○

Dwellings, Buildings and Temporary Settlements Module

EIDITH V 1.3

Add Site and Event Form ID: ○0 ○1 ○2 ○3 ○4 ○5 ○6 ○7 ○8 ○9 (repeated 6 times)

Site name and date:

_____

(For reference only)

1. Is this permanent or temporary human settlement? Select all that apply.
   - ☐ permanent
   - ☐ temporary

2. What is the type of dwelling at sampling site/event? Select all that apply.
   - ☐ home
   - ☐ work
   - ☐ congregation sites
   - ☐ schools/universities
   - ☐ abandoned building

3. Which animal taxa have you observed inside the dwelling and why? Select all that apply for each row.

	not present in dwelling	unwanted animals entering structure on their own	animals near food preparation and eating areas	animals kept as pets	animals raised or kept for food	butchering of animals on site
rodents/shrews	☐	☐	☐	☐	☐	☐
bats	☐	☐	☐	☐	☐	☐
non-human primates	☐	☐	☐	☐	☐	☐
birds	☐	☐	☐	☐	☐	☐
carnivores	☐	☐	☐	☐	☐	☐
ungulates	☐	☐	☐	☐	☐	☐
poultry	☐	☐	☐	☐	☐	☐
goats/sheep	☐	☐	☐	☐	☐	☐
camels	☐	☐	☐	☐	☐	☐
swine	☐	☐	☐	☐	☐	☐
cattle/buffalo	☐	☐	☐	☐	☐	☐
dogs	☐	☐	☐	☐	☐	☐
cats	☐	☐	☐	☐	☐	☐
unknown taxa	☐	☐	☐	☐	☐	☐

4. Is there a healthcare facility that can be accessed within 1 day?
   - ☐ yes
   - ☐ no

5. If yes above, do they have:

	yes	no
capacity for medical treatment?	☐	☐
capacity for preventive services?	☐	☐
a posted ebola or other disease outbreak preparedness plan?	☐	☐
capacity for pharmacy services?	☐	☐

Extractive Industry Site Module

EIDITH V 1.4

Add Site and Event Form ID:

Site name and date:

_____

(For reference only)

0	1	2	3	4	5	6	7	8	9
0	1	2	3	4	5	6	7	8	9
0	1	2	3	4	5	6	7	8	9
0	1	2	3	4	5	6	7	8	9
0	1	2	3	4	5	6	7	8	9
0	1	2	3	4	5	6	7	8	9

1. Is this an existing or planned extractive industry site? Select one option per row.

	none	existing	planned
coal	☐	☐	☐
coltan	☐	☐	☐
diamond or other gemstone	☐	☐	☐
tin	☐	☐	☐
gold/silver	☐	☐	☐
lead	☐	☐	☐
oil/gas	☐	☐	☐
timber/plant	☐	☐	☐
other: _____	☐	☐	☐

2. For each extractive industry at the site, what was the state of land before conversion? Select all that apply.

	undisturbed habitat	protected area	savannah or grassland	agricultural fields	unknown	other: _____	
coal	☐	☐	☐	☐	☐	☐	
coltan	☐	☐	☐	☐	☐	☐	
diamond or other gemstone	☐	☐	☐	☐	☐	☐	
tin	☐	☐	☐	☐	☐	☐	
gold/silver	☐	☐	☐	☐	☐	☐	
lead	☐	☐	☐	☐	☐	☐	
oil/gas	☐	☐	☐	☐	☐	☐	
timber/plant	☐	☐	☐	☐	☐	☐	
other: _____	☐	☐	☐	☐	☐	☐	

3. Which of the following are used to move the resource (e.g., timber, ore, oil) and/or staff to and from the facility? Select all that apply.

- ☐ road
- ☐ rail
- ☐ airstrip
- ☐ port
- ☐ river
- ☐ helipad
- ☐ none

4. Are roads being built at the site? ☐ yes ☐ no

5. Is there a place where meals are provided or food is sold? ☐ yes ☐ no

6. Is there an on-site healthcare facility available to workers? ☐ yes ☐ no

7. If yes, do they have:

	yes	no
capacity for medical treatment?	☐	☐
capacity for preventive services?	☐	☐
a posted ebola or other disease outbreak preparedness plan?	☐	☐
capacity for pharmacy services?	☐	☐

Market and Value Chain Module

EIDITH V 1.2

Add Site and Event Form ID:

Site name and date:

_____

(For reference only)

0 1 2 3 4 5 6 7 8 9
0 1 2 3 4 5 6 7 8 9
0 1 2 3 4 5 6 7 8 9
0 1 2 3 4 5 6 7 8 9
0 1 2 3 4 5 6 7 8 9
0 1 2 3 4 5 6 7 8 9

1. What is the node along value chain? Select one option.
   - ☐ source of animals (area of capture or farm)
   - ☐ animals in transit
   - ☐ distributer/middle man
   - ☐ point of sale

2. How many vendors or workers are at the site/event? Select one option.
   - ☐ only 1 person
   - ☐ <5 people
   - ☐ 5-20 people
   - ☐ 21-100 people
   - ☐ >100 people

3. Which animals are for sale in the market or value chain at this site/event? Select all that apply for each row.

	live	dead	parts	slaughtered at site	none observed
rodents/shrews	☐	☐	☐	☐	☐
bats	☐	☐	☐	☐	☐
non-human primates	☐	☐	☐	☐	☐
birds	☐	☐	☐	☐	☐
carnivores	☐	☐	☐	☐	☐
ungulates	☐	☐	☐	☐	☐
poultry	☐	☐	☐	☐	☐
goats/sheep	☐	☐	☐	☐	☐
camels	☐	☐	☐	☐	☐
swine	☐	☐	☐	☐	☐
cattle/buffalo	☐	☐	☐	☐	☐
dogs	☐	☐	☐	☐	☐
cats	☐	☐	☐	☐	☐

4. What is the maximum number of taxonomic groups in one holding area or cage? Select one option.
   - ☐ 1
   - ☐ 2-5
   - ☐ 6-10
   - ☐ >10

5. Are wild animals and domesticated animals held together in one holding area or cage?
   - ☐ yes
   - ☐ no

6. What types of biosecurity measures are practiced at the facility? Select all that apply.
   - ☐ hand washing facilities
   - ☐ gloves for personnel handling animals or raw animal products
   - ☐ protective clothing and footwear for personnel performing butchering and slaughtering
   - ☐ washing and disinfecting animal crates and equipment in contact with animals or animal products
   - ☐ removal of sick or dead animals from live animal settings
   - ☐ no biosecurity observed

7. What type of animal waste is present at the site/event? Select all that apply.
   - ☐ feces
   - ☐ soiled bedding (urine and feces)
   - ☐ animal tissue and/or blood
   - ☐ none

Add Site and Event Form ID:

Site name and date:

_____

(For reference only)

0	1	2	3	4	5	6	7	8	9
0	1	2	3	4	5	6	7	8	9
0	1	2	3	4	5	6	7	8	9
0	1	2	3	4	5	6	7	8	9
0	1	2	3	4	5	6	7	8	9
0	1	2	3	4	5	6	7	8	9

1. Is this a protected area? ☐ yes ☐ no

2. If yes above, what is the approximate size of protected area in square kilometers? _____

3. If yes above, what is the name of protected area? _____

4. What is the type of setting? Select all that apply.
   - ☐ forest
   - ☐ grassland
   - ☐ riparian/river/stream/lake
   - ☐ wetland
   - ☐ estuary
   - ☐ cave
   - ☐ desert/arid
   - ☐ urban park/garden

5. What are the human impacts in the natural area? Select all that apply.
   - ☐ hunting
   - ☐ tourism/recreational
   - ☐ land clearing for logging
   - ☐ land clearing for infrastructure development (including road building, dams)
   - ☐ land clearing for other extractive industry (eg mining, oil and gas, precious metals)
   - ☐ land clearing for domesticated animal production
   - ☐ land clearing for crop production
   - ☐ temporary human settlement
   - ☐ permanent human settlement
   - ☐ displaced people due to nearby conflict
   - ☐ small scale harvest of food, firewood, medicine, etc for personal/home use
   - ☐ no apparent human impact

Wildlife Restaurant Module

EIDITH V 1.2

Add Site and Event Form ID:

Site name and date:

_____

(For reference only)

0	1	2	3	4	5	6	7	8	9
0	1	2	3	4	5	6	7	8	9
0	1	2	3	4	5	6	7	8	9
0	1	2	3	4	5	6	7	8	9
0	1	2	3	4	5	6	7	8	9
0	1	2	3	4	5	6	7	8	9

1. How would you best describe this restaurant? Select one option.
   - ☐ permanent structure
   - ☐ mobile/semi-permanent structure

2. How many chairs are there at the restaurant (inside and outside)? _____

3. Which taxonomic groups are sold at this restaurant and for what purpose? Select all that apply for each row.

	offered for consumption	held live	sold live	products sold	slaughtered	none observed
rodents/shrews	☐	☐	☐	☐	☐	☐
bats	☐	☐	☐	☐	☐	☐
non-human primates	☐	☐	☐	☐	☐	☐
birds	☐	☐	☐	☐	☐	☐
carnivores	☐	☐	☐	☐	☐	☐
ungulates	☐	☐	☐	☐	☐	☐

4. What type of animal waste is present at the site/event? Select all that apply.
   - ☐ feces
   - ☐ soiled bedding (urine and feces)
   - ☐ animal tissue and/or blood
   - ☐ none

5. Is there a designated area for slaughtering and/or butchering animals? Select one option.
   - ☐ yes, separate from dining area
   - ☐ yes, same as dining area
   - ☐ no

6. What types of biosecurity measures are practiced at the facility? Select all that apply.
   - ☐ hand washing facilities
   - ☐ gloves for personnel handling animals or raw animal products
   - ☐ protective clothing and footwear for personnel performing butchering and slaughtering
   - ☐ washing and disinfecting animal crates and equipment in contact with animals or animal products
   - ☐ removal of sick or dead animals from live animal settings
   - ☐ no biosecurity observed

Zoos and Sanctuaries Module

EIDITH V 1.3

Add Site and Event Form ID:

Site name and date:

_____

(For reference only)

0 1 2 3 4 5 6 7 8 9
0 1 2 3 4 5 6 7 8 9
0 1 2 3 4 5 6 7 8 9
0 1 2 3 4 5 6 7 8 9
0 1 2 3 4 5 6 7 8 9
0 1 2 3 4 5 6 7 8 9

1. What is the purpose of holding the animals? Select all that apply.
   - ☐ public viewing or education
   - ☐ rehabilitation (for release)
   - ☐ sanctuary

2. How many visitors are observed during this event? Select one option.
   - ☐ none (local staff only)
   - ☐ 1-10
   - ☐ 11-100
   - ☐ 101-1000
   - ☐ >1000

3. What is the origin of these visitors? Select all that apply.
   - ☐ local visitors
   - ☐ regional visitors
   - ☐ foreign visitors

4. What is the number and density of held animals at this facility? Select one option per row. If the answer is NOT "none", then write in the number for each enclosure question.

	none	1-10	11-100	101-1000	>1000	number of enclosures	average number of animals per enclosure	average size of enclosure (square meters)	average number of freeranging or tethered animals
rodents/shrews	☐	☐	☐	☐	☐				
bats	☐	☐	☐	☐	☐				
non-human primates	☐	☐	☐	☐	☐				
birds	☐	☐	☐	☐	☐				
carnivores	☐	☐	☐	☐	☐				
ungulates	☐	☐	☐	☐	☐				
poultry	☐	☐	☐	☐	☐				
goats/sheep	☐	☐	☐	☐	☐				
camels	☐	☐	☐	☐	☐				
swine	☐	☐	☐	☐	☐				
cattle/buffalo	☐	☐	☐	☐	☐				
dogs	☐	☐	☐	☐	☐				
cats	☐	☐	☐	☐	☐				

5. Are there multiple taxonomic groups in one holding area or cage?
- ☐ yes
- ☐ no

6. Are wild animals and domesticated animals held together in one holding area or cage?
- ☐ yes
- ☐ no

7. What type of animal waste is present at the site/event? Select all that apply.
- ☐ feces
- ☐ soiled bedding (urine and feces)
- ☐ animal tissue and/or blood
- ☐ none

8. What types of biosecurity measures are practiced at the facility? Select all that apply.
- ☐ hand washing facilities
- ☐ showering facilities
- ☐ footbaths
- ☐ gloves for personnel
- ☐ protective clothing and footwear for personnel and other visitors
- ☐ washing and disinfecting crates or other equipment entering the facility
- ☐ allowing only essential personnel to enter animal buildings
- ☐ quarantine of new and/or diseased animals
- ☐ removal and disposal of dead animals
- ☐ no biosecurity observed

Animal Data

EIDITH V 1.2

Add Site and Event Form ID: 0 1 2 3 4 5 6 7 8 9 (×6 rows)

Site name and date: _____

(For reference only)

1. Animal ID _____

2. Recapture? ☐ yes ☐ no

If different than event include...

3. Sample date: _____ (eg. 2015-Apr-01)

4. Recorder: _____

5. Sample location: Latitude: _____ Longitude: _____

Preferred method - decimal degress

6. Taxa Group - Select one option.

- ☐ rodents/shrews
- ☐ bats
- ☐ non-human primates
- ☐ birds
- ☐ carnivores
- ☐ ungulates
- ☐ pangolins
- ☐ poultry
- ☐ goats/sheep
- ☐ camels
- ☐ swine
- ☐ cattle/buffalo
- ☐ dogs
- ☐ cats

7. Tag/and/Other ID: _____

8. Species Scientific Name _____

9. Species English Name _____

10. Species Local Name _____

11. Animal Classification - Select one option.

- ☐ captive wild animal
- ☐ free-ranging wild animal
- ☐ owned domesticated species
- ☐ unowned domesticated species

12. What is the level of certainty of species identification? Select one option.

- ☐ actual
- ☐ estimate
- ☐ unknown

13. Age Class
Select one option.

- ☐ fetus
- ☐ neonate
- ☐ subadult
- ☐ adult
- ☐ unknown

14. Condition
Select one option.

- ☐ alive
- ☐ alive (non-invasive sample collection)
- ☐ dead (fresh carcass)
- ☐ dead (>48 hours)

15. Sex
Select one option.

- ☐ male
- ☐ female
- ☐ unknown

16. Was a necropsy or exam conducted?

	yes	no
necropsy	☐	☐
physical exam	☐	☐

17. If answered yes to necropsy, what is observed?

_____

_____

_____

18. Estimate health status at sampling. Select one option.

- ☐ apparently healthy
- ☐ sick
- ☐ injured
- ☐ unknown

19. Preservation Method (only if dead) - Select all that apply.

- ☐ cooked
- ☐ dried
- ☐ fermented
- ☐ frozen
- ☐ powdered
- ☐ preserved in liquid
- ☐ salted
- ☐ smoked
- ☐ not preserved

20. Specify clinical signs if found sick or injured. Select all that apply.

- ☐ abscesses
- ☐ abdominal mass
- ☐ amputated body parts
- ☐ broken bones
- ☐ contusions
- ☐ dermatitis
- ☐ diarrhea
- ☐ emaciated
- ☐ external parasites
- ☐ hair loss
- ☐ in shock
- ☐ lacerations
- ☐ lethargic
- ☐ nasal discharge
- ☐ non-responsive
- ☐ paralysis
- ☐ respiratory symptoms
- ☐ skin lesions
- ☐ skin mass
- ☐ swelling
- ☐ other: _____

21. Select the animal to human interfaces that best describe the animal's contact with people in this setting. Select all that apply.

- ☐ hunted
- ☐ for sale in restaurant
- ☐ for sale in small market (< 5 vendors)
- ☐ for sale in medium market (5-20 vendors)
- ☐ for sale in large market (> 20 vendors)
- ☐ private sale
- ☐ raiding markets
- ☐ raiding crops
- ☐ preying on livestock or their food
- ☐ public safety hazard (e.g. threat to humans)
- ☐ in human dwelling
- ☐ at abattoir/slaughterhouse
- ☐ at temporary holding facility in value chain
- ☐ in transit along the value chain
- ☐ private wildlife collection or pet
- ☐ zoo
- ☐ wild animal farm
- ☐ guano or manure farm
- ☐ sanctuary
- ☐ rehabilitation center
- ☐ within 10m of tourists/ ecotourism
- ☐ within 10m of park personnel in intensive wildlife management area
- ☐ within 10m of researchers (other than PREDICT staff)
- ☐ within 10m of workers in extractive industry
- ☐ within 10m of workers harvesting crops
- ☐ contact with domestic animals or humans NOT likely
- ☐ other _____

22. If this animal or animal product is being produced or sold, what is the intended use of the animal product? Select all that apply.(Associated with animal production, wildlife restaurant or market and value chain modules)

- ☐ food
- ☐ medicine
- ☐ pet
- ☐ research
- ☐ souvenir/trophy
- ☐ spiritual
- ☐ zoo/education
- ☐ unknown
- ☐ other:_____

Specimen Data EIDITH

V 1.2

Add Animal Data Form ID: 0 1 2 3 4 5 6 7 8 9

Site name and date: _____

(For reference only)

1. Specimen ID: _____ 2. Animal ID: _____

(For your records)

3. Specimen Type - Select one option.

internal fluids

- ○ bile
- ○ cerebrospinal fluid
- ○ milk
- ○ pericardial fluid
- ○ peritoneal fluid
- ○ pleural fluid
- ○ stomach content
- ○ urine

posterior

- ○ cloacal swab
- ○ feces
- ○ guano
- ○ rectal swab
- ○ prepucial swab
- ○ urine/urogenital swab
- ○ vaginal swab
- ○ for future use do not use

anterior

- ○ choanal swab
- ○ nasal swab
- ○ nasopharyngeal swab
- ○ ocular swab
- ○ oral swab
- ○ saliva
- ○ sputum

tissue

- ○ tissue

blood products

- ○ blood clot
- ○ blood (whole)
- ○ buffy coat
- ○ plasma
- ○ red blood cells
- ○ serum

environmental sample

- ○ environmental sample

other specimen type

- ○ other _____

4. If "tissue", select the type.

- ○ adrenal
- ○ cecum
- ○ colon
- ○ duodenum
- ○ heart
- ○ kidney
- ○ liver
- ○ lung
- ○ muscle
- ○ ovary
- ○ pancreas
- ○ spleen
- ○ testes
- ○ lymph node: _____
- ○ other: _____

5. Specimen Medium

- ○ 10% buffered formalin
- ○ lysis buffer
- ○ RNA later
- ○ trizol
- ○ viral transport media (VTM)
- ○ no medium

6. Specimen Container

- ○ cryotube
- ○ glass jar
- ○ plastic container
- ○ whirl pack
- ○ other: _____

7. Specimen Storage Method

- ○ ultra low freezer (-80c)
- ○ freezer (-20c to -40c)
- ○ liquid nitrogen
- ○ room temperature
- ○ other: _____

8. Storage facility _____

9. Storage location within facility _____

PREDICT Training Event Form

EIDITH v1_2

Date* _____

* Required Field

Participant Information

First Name* _____ Last Name* _____

Gender* Female ☐ Male ☐ Unknown ☐

PREDICT Staff?* ☐ Yes ☐ No

Student?* ☐ Yes ☐ No ☐ Unknown

Organization*
- ☐ NGO
- ☐ Government ministry
- ☐ Government lab
- ☐ Research Institute
- ☐ University
- ☐ Other: _____

Organization Name
_____
_____
_____
_____
_____
_____

Training Information

Workforce development training?*

Was training part of "on the job" training, continuing education, or other type of training to enhance capacity to conduct current work? ☐ Yes ☐ No ☐ Unknown

Refresher Training?*
☐ Yes ☐ No ☐ Unknown

Trainer First Name* _____ Last Name* _____

Training Topic*

What was the topic of the training session? Select all that apply.

General Training Topics

- ☐ Behavioral Surveillance & Qualitative Research Methods
- ☐ Biosafety and PPE
- ☐ Cold Chain
- ☐ Emergency Preparedness & Response
- ☐ GIS & Spatial Analysis
- ☐ Information Management
- ☐ Modeling & Analytics
- ☐ One Health Approach
- ☐ Outbreak Response
- ☐ Packing & Shipping Biological Samples
- ☐ Safe Sample Transport & Storage
- ☐ Other:_____

Field Training Topics

- ☐ Avian Sampling
- ☐ Bat Sampling
- ☐ Bushmeat Sampling
- ☐ Camel Sampling
- ☐ Human Biological Sampling
- ☐ Livestock Sampling
- ☐ Non-Human Primate Sampling
- ☐ Rodent Sampling
- ☐ Safe Animal Capturing
- ☐ Small Carnivore Sampling
- ☐ Other:_____
- ☐ Do not use For future use

Lab Training Topics

- ☐ Lab Protocols & Diagnostics
- ☐ Lab Safety
- ☐ Other:_____

PREDICT Training Event Form

Location of Training *

- ☐ Bangladesh
- ☐ Burma/Myanmar
- ☐ Cambodia
- ☐ Cameroon
- ☐ China
- ☐ Cote d'Ivoire
- ☐ DR Congo
- ☐ Egypt
- ☐ Ethiopia
- ☐ Gabon
- ☐ Ghana
- ☐ Guinea
- ☐ Jordan
- ☐ Kenya
- ☐ India
- ☐ Indonesia
- ☐ Laos PDR
- ☐ Liberia
- ☐ Malaysia
- ☐ Mongolia
- ☐ Senegal
- ☐ Sierra Leone
- ☐ South Sudan
- ☐ Republic of Congo
- ☐ Rwanda
- ☐ Tanzania
- ☐ Thailand
- ☐ Uganda
- ☐ United States
- ☐ Vietnam

Training duration? *

- ☐ <4 hours
- ☐ 1/2 a day
- ☐ 1 day
- ☐ >1 day (include number of days)_____
- ☐ Unknown

Training completed? *

- ☐ Yes
- ☐ No

Training certified?

Did participant receive a training certificate?

- ☐ Yes
- ☐ No
- ☐ Unknown

General notes or feedback on the training session

6.3. BEHAVIORAL RISK – NEW OBSERVATIONAL AND QUALITATIVE RESEARCH PROTOCOL, TOOLS AND TRAINING MATERIALS

PREDICT uses a multidisciplinary approach to identify groups of populations at highest risk of exposure to emerging pathogens, and the 'how' and the 'why' of risk. Our teams assess community perceptions of animal exposure and disease risk and evaluate widely-held assumptions of community practices (e.g., high risks from bushmeat hunting). PREDICT is identifying and monitoring the risk factors for zoonotic diseases with pandemic threat potential. Our methods will lead to well-rounded understanding of disease spillover and transmission dynamics, essential to the design and evaluation of mitigating interventions, and to informing policy by identifying barriers to change and acceptable alternatives.

This year, PREDICT developed and standardized observational and qualitative research methods for behavioral risk activities and began training and implementation of these methods in multiple countries (for details and achievements see Section 1, Objective 3). Products developed and in use include the "PREDICT-2 Qualitative Research for Behavioral Risk Surveillance and Characterization" protocol, the ethnographic interview and focus group guides, and a protocol for observational research. The full suite of training materials for PREDICT's behavioral risk activities will be available in the PREDICT e-Book in Year 2.

1) PREDICT 2: Qualitative Research for Behavioral Risk Surveillance and Characterization
Protocol date: May 4, 2015

2) Authors: UC Davis Researchers & Researchers from other institutions

3) IRB Review History

This protocol, which we are submitting for expedited approval, has not been submitted for IRB review by any other institutions or at any other time. A brief protocol expressly focused on pilot testing behavioral data collection instruments was submitted to Western Institutional Review Board for exemption by PREDICT partner Metabiota, and was approved on April 6, 2015.

PREDICT is a collaborative disease surveillance and capacity strengthening program funded through the USAID Emerging Pandemic Threats (EPT) program and the geographic scope of program activities, including those involving human subjects is dynamic and subject to change. Currently PREDICT is active in 17 countries in Africa and South and Southeast Asia: Bangladesh, Cambodia, Cameroon, China, Democratic Republic of Congo (DRC), Gabon, Indonesia, Lao PDR, Malaysia, Myanmar, Nepal, Republic of Congo (RoC), Rwanda, Tanzania, Thailand, Uganda, and Vietnam. PREDICT activities will commence in additional 14 countries (Cote d'Ivoire, Egypt, Ethiopia, Ghana, Guinea, India, Jordan, Kenya, Liberia, Mongolia, Philippines, Senegal, Sierra Leone, and South Sudan) between May and September 2015. *Additional description of the study sites in the countries currently participating in the PREDICT project is included under #23 "Setting" below.*

PREDICT will seek approval for research activities under this study from all participating countries through Institutional Review Boards, ethical clearance councils/committees, and national research administrations following local regulatory guidelines as appropriate.

4) Objectives

Nearly 75 percent of all new, emerging, or re-emerging diseases affecting humans at the beginning of the 21st century are zoonotic (i.e. originated in animals). Notable examples of the global impact of new emergent diseases include HIV/AIDS, severe acute respiratory syndrome (SARS), and most recently Ebola. The speed with which these diseases can emerge and spread represents serious public health, economic, and development concerns. The vast majority of these diseases originated in "hot spot" areas such as central Africa, and South and Southeast Asia where multiple and complex factors contribute to zoonotic disease spillover into human populations.

The EPT program works in developing countries to prevent, detect, and

control infectious diseases in animals and people with an emphasis on early identification of, and response to, dangerous pathogens from animals before they become significant threats to human health. The PREDICT project, as part of the EPT program, has two specific goals in support of this work:

1. To identify populations and settings where there is a high risk of zoonotic disease spillover from animals to humans.

2. To develop policies and intervention strategies, which reduce the risk of zoonotic spillover.

The PREDICT project has identified three key 'pathways' of risk. Based on previous research and experience, the 'pathways' have been developed to identify the settings where humans, wildlife, and livestock or domestic animals are most likely to come into contact with each other in a way that increases the risk of zoonotic disease spillover from animals to humans.

1. **Land Conversion for commercialization.** Rapidly changing landscapes that bring humans and animals in closer contact than was previously experienced (e.g. palm oil plantations, mining, logging, crops).

2. **Intensification of Animal Production Systems.** To feed growing global populations there have been major increases in the number of livestock (e.g. chickens, cows, goats) being raised using industrial methods. Frequent direct human- livestock contact occurs, often intermingling with wildlife species, in settings that vary in sanitation.

3. **Animal Value Chains.** Wildlife and domestic animals from remote naturally biodiverse regions are brought to densely populated urban markets that actively trade in varied animal species and products.

A key aim of PREDICT is to better understand the human behaviors and practices that may increase the risk of zoonotic disease spillover, as well as the social, environmental and economic factors that underlie human behaviors and practices. PREDICT is also working to identify potential policy approaches and interventions that could mitigate zoonotic disease transmission risk posed by human-animal interactions in targeted communities. As the first step in this process, qualitative research methods will be used to help identify and understand behaviors associated with zoonotic disease transmission risk. These proposed methods will also help in understanding any alternative futures imagined by people in targeted communities, along with the activities required to achieve those futures to better inform the development of effective policy and intervention strategies.

Human behaviors and practices are key risk components for pathogen spillover, amplification, and spread. We will characterize the type and frequency of contact among people, domestic animals, and potential wildlife reservoirs and investigate the correlation of specific human behaviors and zoonotic disease risk across sites to more deeply understand the behavioral mechanisms involved in the high-risk pathways. Through qualitative research methods, we will identify and monitor behaviors, attitudes, practices, and socio-cultural norms and conditions that facilitate animal-human and animal-animal contact and any alternative futures of individuals in our target communities that might inform potential policy and intervention strategies. We plan to integrate data from behavioral risk characterization, and economic and anthropologic studies using advanced informational technologies and a dynamic analytical framework to identify potential targets for intervention and informed policy development.

Our guiding hypothesis is that risks for disease transmission and spread differ according to behavioral factors. In addition to understanding the contributions of ethnicity/cultural group, occupation, age, gender, our intent is to understand people's behaviors related to contact with wild and domesticated animals and the factors motivating those behaviors, such as occupational exposure in markets or extractive industry zones, or hunting, preparation, consumption and other exposures to wild and domestic animal meat, in order to develop an evidence base for identifying appropriate interventions and messages to decrease exposure to emerging infections.

We will conduct investigations using standardized qualitative research methods in each participating country, including observation, in-depth structured interviews, and focus groups that include a participatory risk mapping exercise. To the extent feasible, data sets collected will include:

- Data on human movements (i.e. home, work, travel, and observed environment), behaviors, and practices and the ecological conditions governing these aspects of human ecology
- Data on socioeconomics (i.e. daily routine, animal responsibilities, education, and economics)
- Data on biosecurity in human environments (i.e. water and food, sanitation, and hygiene)
- Data on illness, medical care/treatment and death of humans (i.e. household illness, illness from animals, medical care/treatment, and death)
- Data on human-animal contact (i.e. indirect contact, direct contact, animal products/rituals, animal health, and perceptions/knowledge)
- Analyses of key characteristics of human behaviors and practices
- Qualitative investigation into risky exposure practices associated with the key pathways of risk (referenced above).

5) Background

Over the past decade, attempts to control deadly viruses like SARS

Coronavirus, Middle Eastern Respiratory Syndrome (MERS), and Influenza have been, out of necessity, almost entirely reactionary. Due in large part to USAID's Pandemic Influenza and Other Emerging Threats Program, the world is poised to move beyond that costly approach, which measures impact in death tolls and money spent on diagnosis, treatment and containment. The time is right for a more proactive paradigm that allows for use of knowledge of what diseases might be emerging and the development of interventions to prevent or at least control the pathogens at their source.

The premise of One Health is that people, animals and the environment form an interdependent ecosystem that needs to be considered in a coordinated manner (FAO et al., 2008; Frank, 2008). It rests on a conceptually simple model that focuses on contact and therefore the potential for transmission of disease between wild and domestic animals and humans (usually depicted as three overlapping circles) in the context of the environment. This model has worked well as an advocacy tool to present the case for coordination in detecting and responding to outbreaks. It has also fostered discussions on the factors that are contributing to spillover of diseases from animals to humans, the first step in an outbreak.

PREDICT 2 is a consortium consisting of teams from the University of California, Davis (UCD), EcoHealth Alliance (EHA), Metabiota (MB), the Smithsonian Institute (SI), and the Wildlife Consortium Society (WCS) using a One Health approach to strengthen capacity and improve zoonotic disease prevention, detection, and response. From 2009-2014, the Consortium developed and stewarded the first PREDICT project in Africa, Asia and SE Asia, and Latin America. Working closely with at least 59 government ministries and dozens of scientific institutions, local organizations, and other stakeholders, the Consortium significantly advanced One Health capacity and infrastructure in these countries. By developing robust mechanisms for overcoming geographic and disciplinary constraints to public health protection, the Consortium established multidisciplinary collaborations and established systems for data sharing and interpretations across Ministries. High-risk human-wildlife interfaces were selected for investigation as targets of opportunity for viral spillover from wildlife hosts to humans and their food animals. Human and animal samples were screened for viral families suspected to be sources for new pathogens impacting people, using novel high-efficiency, high-volume molecular (consensus PCR) techniques that have been readily deployable (technically and financially) in developing countries. In the first five years, the PREDICT Consortium detected a total of 984 unique viruses (815 novel viruses and 169 known viruses) in wild animals and humans, and worked to combine these discoveries with data on rates and types of human-wildlife contact to assess risk and inform mitigation strategies.

Building on these achievements, the Consortium is now incorporating a focus on human behaviors that may amplify risks for disease transmission

and spread between animals and people through qualitative research, targeting places where environment and market systems are changing in ways that are conducive to the viral spillover from animals to people. Working on the ground with our local teams, which include health professionals, scientists, educators, and ministry officials, PREDICT will conduct qualitative research to identify areas and behaviors posing the highest risk for exposure to disease, and provide information needed to efficiently design and target intervention strategies at human behaviors that facilitate disease emergence and amplification.

There is very limited data as to the exact mechanisms of spillover transmission from animals to humans. A primary goal of the human behavioral research is to develop a better understanding of which human behaviors and practices are the transmission mechanisms, and under what circumstances these behaviors facilitate spillover.

6) Inclusion and Exclusion Criteria

The study will include adults and children (defined as 10 to 17 years old) living or working in the study sites selected by PREDICT as priority surveillance sites with high risk for viral spillover, evolution, amplification, and spread (i.e., 'hotspots'). PREDICT study sites are prioritized by identifying areas considered high-risk for contact with taxonomic groups known to be associated with zoonotic viral diversity and with ecological and epidemiological conditions associated with disease emergence.

Inclusion criteria: Residents of targeted communities (potential hot spots.

Ethnographic interviews
Only people who are willing to be recorded can participate in interviews in this study. In order to participate in a targeted ethnographic interview, an individual must have contact with live animals. Direct contact includes raising, hunting, selling, trading or purchasing live animals. Indirect animal contact includes animals living in or entering dwellings, buildings or gardens/crops (e.g., bat roosts along roofs, rats or other animals invading stored food or crops).

The interviewer will work with the Country Coordinator or Field Coordinator, as well as local contacts, for introductions to individuals who are eligible and interested in being interviewed.

Approximately 35-40% of participants will be women. Efforts will be made to include a large variety of people, including those of different religions or ethnicities, younger people and older people, and people who have more power or influence (e.g., farm owners), as well as those with less (e.g. market cleaners). It is anticipated that no more than 10% of interviews will be with children less than 18 years of age (but no younger than 10). Children <18 years of age will only be allowed to participate if one parent is present to provide consent and the child provides assent for participation.

Focus groups
Only adults will be recruited for participation in focus groups. In order to participate in a targeted focus group, an individual must have contact with live animals. Direct contact includes raising, hunting, selling, trading or purchasing live animals. Indirect animal contact includes animals living in or entering dwellings, buildings or gardens/crops (e.g., bat roosts along roofs, rats or other animals invading stored food or crops). The moderator will work with the Country Coordinator or Field Coordinator, as well as local contacts, for introductions to individuals who are eligible and interested in participating in a focus group.

One focus group per country will consist of only women. Efforts will be made to include a large variety of people, including those of different religions or ethnicities, younger people and older people, and people who have more power or influence (e.g. farm owners), as well as those with less (e.g. market cleaners).

Exclusion criteria: Refusal to provide informed consent (both interviews and focus groups) and refusal to be recorded (interviews only).

The study will only be conducted after obtaining ethical approval/exemption from local institutional review boards. This study does not include invasive or medical procedures, or medical devices of any kind. Participation in the study will be strictly voluntary. Participants will be given an information sheet prior to being asked to participate in this study.

7) Number of Subjects

The study will target sites planned for inclusion in the PREDICT 2 surveillance program. This is a multi-site study, and we expect to enroll and conduct ethnographic interviews with a maximum of
100 participants per country (3,100 total); approximately 7-10 individuals per site, with children making up no more than 10% of individuals interviewed at each site. All interviews will be conducted by a team trained and supervised by our PREDICT partners at local implementing institutions.

We expect to enroll and conduct focus groups with a maximum of
50 participants per country (1,550 total); approximately 6-10 individuals per site. No children will be recruited for focus group participation. All focus groups will be conducted by a team trained and supervised by our PREDICT partners at local implementing institutions.

8) Recruitment Methods

No advertising materials, printed or broadcasted, will be used to recruit subjects. Research procedures in the current study will not include accessing personal health information.

Ethnographic interviews
In order to participate in a targeted ethnographic interview, an individual must have contact with live animals. Direct contact includes raising, hunting, selling, trading or purchasing live animals. Indirect animal contact includes animals living in or entering dwellings, buildings or gardens/crops (e.g. bat roosts along roofs, rats or other animals invading stored food or crops).

The interviewer will work with the Country Coordinator or Field Coordinator, as well as local contacts, for introductions to individuals who are eligible and interested in being interviewed. Approximately 35-40% of participants will be women. Efforts will be made to include a large variety of people, including those of different religions or ethnicities, younger people and older people, and people who have more power or influence (e.g. farm owners), as well as those with less (e.g. market cleaners).

Focus groups
In order to participate in a targeted focus group, an individual must have contact with live animals. Direct contact includes raising, hunting, selling, trading or purchasing live animals. Indirect animal contact includes animals living in or entering dwellings, buildings or gardens/crops (e.g. bat roosts along roofs, rats or other animals invading stored food or crops).

The moderator will work with the Country Coordinator or Field Coordinator, as well as local contacts, for introductions to individuals who are eligible and interested in participating in a focus group.

One focus group per country will consist of only women. In some cultures, women may not be comfortable speaking in front of elders or rich people, while in others, women may not be comfortable speaking in front of men of any age. It is important to understand gender perspectives, since several zoonotic infections have been found to be more common in women (e.g., HIV).

Efforts will be made to include a large variety of people, including those of different religions or ethnicities, younger people and older people, and people who have more power or influence (e.g. farm owners), as well as those with less (e.g. market cleaners).

Research subjects will be recruited for participation in the study by a local researcher from a PREDICT 2 implementing institution. The study will recruit adults and children aged 10 or older either living at the site or working or visiting the site by asking individuals if they would like to participate. The study is completely voluntary.

To ensure compliance with informed consent procedures, all potential participants and parents of potential minor participants will be given an information sheet prior to being asked to participate in the study. The participant will review the information sheet with the research staff and will

be given time to ask questions. Children aged 10 or older will only be allowed to participate if one parent is present to provide consent and the child provides assent for participation. When reviewing the information sheet, study staff will explain details of the study including why they were selected, potential risks to their participation, how their participation is beneficial, that their participation is completely voluntary, and that they can withdraw their participation at any time.

9) Compensation to the Subjects

Interviews/ Focus Groups
In each country, the Country Coordinator or Field Coordinator will identify an item as a token of appreciation to give to each study participant. This item will be appropriate for the context of the country, the study population, and equivalent to no more than $10 USD. The token of appreciation will be given at the end of the interview or focus group.

10) Study Timelines

The study is supported by a USAID $100 million five-year cooperative agreement with the UC Davis One Health Institute. PREDICT 2 and this component project is budgeted and planned for five years (end date of September 30, 2019). However, after five years, USAID may extend the program for an additional five years. We anticipate that it will take the entire 5 years for anticipated enrollment in all PREDICT2 countries and for completion of the study.

11) Study Endpoints

The primary endpoint for this study is the characterization of behavioral risk factors associated with disease transmission. Secondary endpoints are the reporting of findings to partners in all implementing countries, to build awareness of zoonotic disease transmission risk and potential prevention and control options.

We anticipate that it will take the entire 5 years for anticipated enrollment in all PREDICT 2 countries and for completion of the study.

12) Procedures Involved

UCD and US-based researchers from the PREDICT Consortium have designed the study, developed all training materials, and will support implementing teams in each participating country through training in all procedures and methods, in the supervision of study implementation, in data management and analyses, and in the development of any subsequent publications from study findings and outreach materials. UCD and US-based researchers will not directly interact with research subjects as the study is designed for implementation by local in-country research teams and will be conducted in the local languages of each targeted site.

Training of research team

All study staff involved in the implementation of this research will be trained to have a clear understanding of the study objectives, the study instruments, their roles in the study, and the need for good quality data. PREDICT team members will train study staff. Individuals from the PREDICT team who are trained (either by CITI or through University of California Davis) will train local research teams in the conduct of ethical research. During local trainings, we will include individuals who have experience in qualitative research studies and with targeted communities. Records will be maintained of all trained local research personnel and unless a researcher has participated in the full training, they will not be allowed to work in this study.

Training will include an overview of the project and project goals, research ethics, and informed consent guidelines and implementation practices, introduction to ethnographic interviewing with a deep focus on the interview guide, introduction to conducting focus groups with attention to the participatory risk mapping exercise and guiding discussion and practice interviews/focus groups. Coding and preliminary data analysis methods will also be taught. Other topics to be covered include: non-verbal communication, probing for additional information, the voluntary nature of the study, sexual harassment, and confidentiality in data collection. Skills such as how to communicate appropriately with villagers and key informants will also be taught and practiced. Training will emphasize pairing interviewers with participants by sex along with measures to assure the respect, dignity and freedom of each participant. Criteria will be developed for the selection of study staff to ensure that data are collected by competent, empathetic, and trainable individuals.

Enrollment, consent, and confidentiality procedures

Each participant will review the information sheet with the research staff and will be given time to ask questions. When reviewing the information sheet, study staff will explain details of the study including: why they were selected, potential risks to their participation, how their participation is beneficial, that their participation is completely voluntary, and that they can withdraw their participation at any time. The researchers will not share responses, and a small token of appreciation will be given for their time spent in the study. Gifts will not be money and will be valued at no more than 10 USD. Measures will be taken to assure the respect, dignity and freedom of each participant. During training of study staff, we will emphasize the importance of avoiding coercion of any kind.

During individual interviews, confidentiality of study subjects will be emphasized. Individual interviews will be conducted in private, ensuring that others cannot hear the interviews. Individual sessions will be held in areas where there are no other individuals within a 10-foot distance. A barrier will be created so that no other individuals can view the participants while they are in their interview. Depending on the location, this could be a

private room, behind a building or fence, or behind a line of trees, obstructing view so that confidentiality may be maintained. The interview team will take care to pair interviewers and respondents by sex to ensure protection of women and children and privacy and confidentiality of responses. Children will not be interviewed in the absence of a parent or guardian.

Steps in the Interview Process

1. Recruit eligible individuals
2. Review the information sheet, allow for questions, and ask for voluntary participation
3. Conduct the ethnographic interview/
4. Provide a token of appreciation to the participant
5. Complete the interview checklist
6. Upload ethnographic interview to computer as soon as possible for transcription

The targeted ethnographic interviews are scheduled for completion within a 4 to 8 week time frame. This includes training, interviewing, and preliminary data analysis. Approximately 60 to 100 individuals will be interviewed in each country. Interviews will last between 60 and 90 minutes. A trained team member will conduct targeted ethnographic interviews with individuals from the 'target population'. The targeted ethnographic interview will take the form of a semi-structured and guided conversation. The topics of conversation have been well defined (see Ethnographic Interview Guide, Appendix B).

Recorded interviews will be uploaded to a computer as soon as possible after the interview is completed. These interviews will then be transcribed and translated to English.

Materials/devices needed for the ethnographic interview: Pen, participant information sheet, interview guide, fully charged tape recorder or PIN protected smartphone equipped with a digital recorder (owned by and provided to interviewers by PREDICT), token of appreciation, checklist, and computer.

Steps in Conducting a Focus Group

1. Recruit eligible individuals
2. Review the information sheet, allow for questions, and ask for voluntary participation
3. Review the Focus Group Rules
4. Conduct the focus group
5. Token of appreciation given to each participant.
6. Upload the focus group recording to computer and transcribe the focus group discussion as soon as possible

The targeted focus groups are scheduled for completion within a 4 to 8 week time frame in each country. This includes training, conducting the focus group, and preliminary data analysis. Approximately 20 to 50 individuals will participate in focus groups in each country. Focus groups will last between 60 and 90 minutes.

Targeted focus groups will be conducted by two people, one who leads the discussion (the moderator) and the recorder/observer who supports the moderator. Focus groups will be conducted with a group of 6 to 10 people from the 'target population.' The moderator will begin with an animal naming exercise, followed by a short participatory risk mapping exercise. On a blank whiteboard, the moderator will begin by marking the current location where the focus group is meeting. The moderator will then ask the group members to identify settings where each mammal and avian species may be found. This exercise is designed to assess the distribution and overlap of animals. This portion of the focus group will be limited to 15 minutes. The map created by the group will then serve as a reference for discussion. The discussion will be semi-structured and guided. The topics of discussion for the group have been well defined (see Focus Group Guide, Appendix C).

The moderator will introduce each question and will try to encourage all focus group participants to contribute to the discussion. The moderator will ask follow-up questions (probing), until the topic is exhausted and no new information is learned. The moderator will make sure that all voices are heard, and that the participants share a full range of information. The recorder/observer will observe the behaviors and responses of the focus group participants, as well as record key notes on the topics discussed, particularly any new or unique information. The recorder/observer may also suggest additional follow-up questions to the moderator. The recorder/observer will also tape record the focus group. Recorded focus group discussions will be uploaded to a computer as soon as possible after the focus group is completed. These focus group discussions will then be transcribed and translated into English, if necessary.

Materials/devices needed for the focus group: Pens, participant information sheet, Focus Group Guide, fully charged tape recorder/smart phone, token of appreciation, large piece of paper or white board for community mapping, colored markers, and computer.

13) Data and Specimen Banking

No biological specimens will be collected under this protocol's activities. All interviews/ and focus groups will be conducted in the local language and translated to English for entry into an electronic database. Data will be recorded without identifiers.

All data collected will be put into an electronic database. Study findings will also be aggregated. UC Davis and U.S.-based Consortium team

researchers contributing to study design and development will only be involved in training and will not be involved in data collection or field activities.

14) Data Management and Confidentiality

As noted in *Procedures* above, to ensure compliance with informed consent procedures, all participants will be given an information sheet prior to being asked to participate in this study. Each information sheet will be assigned a unique identification (ID) number **before** the ethnographic interview or focus group takes place. No identifying information of the participant will be collected; information obtained will be recorded in such a manner that participants cannot be identified directly or through identifiers linked to the participant, as there will be no identifiers.

Since the focus group activity participants may know one another, we will request that participants not disclose or repeat any information discussed during the focus group to non-participants.

If an individual declines to participate, the reason for non- participation will be asked to determine if we have selected a biased sample in any way: gender and age will be estimated, as will occupation, religion, and ethnicity if relevant and possible. The information sheet (with unique ID) will be kept for the records and used to determine a rate of participation.

Data generated from the interviewer checklist and audio files from recorded interviews in each country will be digitized and stored electronically in a password-protected file accessible only to local PREDICT team country coordinators. All recordings will be transferred to project computers and deleted from the recording device (digital recorder or smartphone enabled recorder) and stored in password-protected files for transcription and coding. Following transcription and coding, encrypted data intended for analyses will be electronically transferred to and stored in the secured PREDICT project database accessible only to country coordinators and the research team as appropriate. The original checklists (and recordings as noted above) will be destroyed or deleted as appropriate upon confirmed receipt and transfer of the encrypted electronic documents and files.

15) Provisions to Monitor the Data to Ensure the Safety of Subjects

The current study involves collection of behavioral data only, with minimal risk to subjects. No identifiers will be collected.

As such, the study is proposed for IRB exemption and involves minimal risk to subjects.

16) Withdrawal of Subjects

There are no foreseeable reasons to withdraw from the study, as participants are only required to provide a relatively short amount of their time depending on the activity, with focus groups and participatory mapping likely requiring the most time (up to two hours). In the event that participants wish to terminate their participation in any of the qualitative research activities (focus groups, interviews, or mapping activities), the research team will comply, the recording will be destroyed, and corresponding data will not be included in storage or analysis. Under no circumstances will subjects be withdrawn from the study without consent.

17) Risks to Subjects

The proposed study involves tape-recording of ethnographic interviews and focus groups. The only risk to participants is loss of confidentiality. Confidentiality safeguards include not collecting any identifiers and password protected storage of encrypted electronic copies of data. The activity is completely voluntary and due to procedures for the protection of all subjects' identifying information as described above, no foreseeable risks, discomforts, hazards, or inconveniences are anticipated.

18) Potential Benefits to Subjects

This study involves the collection of qualitative research data through ethnographic interviews, and focus groups with participatory mapping activities. As such, there is no direct benefit for participation. Indirect benefits include enhanced understanding of disease risks and identification of behaviors facilitating transmission and spread of infectious diseases in the participating communities.

19) Vulnerable Populations

Pregnant women will be given the option to participate in this study. Children aged 10 and older will also be invited to participate. All children will be required to be accompanied by one parent, to provide assent or consent as age-appropriate, and the parent will need to give parental consent for participation. This will be done through the information sheet process as described above. Prisoners will not be included in this study.

20) Multi-Site Research

This is a multi-site study and research activities will be implemented in all participating PREDICT countries (see #3 above).

Activities at the country-level will be governed by local ethical clearance councils and institutional review boards, from which approval will be sought prior to implementation of any activities.

Training on and adherence to study protocols, ethics, and conduct of research activities for all participating personnel will be supervised by project PIs and U.S.-based PREDICT Consortium research team in coordination with the PREDICT Human Subjects Research Working Group. All U.S.-based research personnel working on this study are included on this protocol. Communication among all sites, tracking of research activities, adherence to protocols, and disclosure of results and study completion will be conducted through PREDICT's Operations Officer at UC Davis (D. Wolking).

21) Community-Based Participatory Research

This study does not involve community-based participatory research.

The Focus Group Guide for this project includes a "participatory risk mapping exercise". ' The moderator will begin with an animal naming exercise, followed by a short participatory risk mapping exercise. On a blank whiteboard, the moderator will begin by marking the current location where the focus group is meeting. The moderator will then ask the group members to identify settings where each mammal and avian species may be found. This exercise is designed to assess the distribution and overlap of animals. The map created by the group will then serve as a reference for discussion. This introductory step also allows the moderator to identify participants who may try to dominate the discussion, as well as those who may be shy.

22) Sharing of Results with Subjects

The PREDICT project encourages communicating research findings to the community. Data from this study will be summarized and general findings from this study with respect to overall risk of zoonotic disease transmission will be shared at the community level through participating sites and with relevant authorities via implementing partners.

23) Setting

PREDICT is geographically focused on countries Asia (focus on South and Southeast Asia), Africa (focus on West Africa, the Congo Basin, and East Africa), and the Middle East and targets disease surveillance in areas considered hotspots for infectious disease spillover from wildlife and amplification and spread into domestic animal, livestock, and human populations. As indicated above, all 31 PREDICT countries (see #3 for details) have the option to participate in this study subject to local ethical clearances and permissions.

For this study, sites for qualitative data collection in each country will focus on areas identified by the local PREDICT country teams as priority sites for characterizing behavioral risks associated with emerging disease threats

using criteria specific to each planned activity as indicated below.

Locations of the interviews and focus groups will be in targeted 'hotspot' areas and determined ahead of time by each moderator. Sites will be selected to ensure inclusion of individuals that have contact with live animals through either direct contact (raising, hunting, selling, trading, or purchasing) or indirect contact (animals living in or entering dwellings, buildings, or gardens/crops). Specifically by activity:

Ethnographic Interviews
Interview locations will be identified before the interview and will be conducted in a quiet and private place in areas where there are no other individuals present within a 10-foot distance. Specific sites for interviews depend on the type of targeted "hotspot" area and may be inside wildlife restaurants, behind animal storage sheds, in private rooms if in dwellings or in offices of business owners, etc. When necessary, a barrier will be created so that no other individuals can view the participants while they are in their interview so that confidentiality may be maintained.

Focus groups
Focus group moderators will work with Country Coordinators in each participating country to select appropriate locations to ensure privacy for group participants during the discussion. Consent will be obtained using the information sheet (describe below) and the study team will request that participants not disclose or repeat any information discussed during the focus group to non-participants.

For a list of PREDICT countries, please see #3 above. For more information on the process for local scientific and ethical review structure at the country-level see #20 above and #25 below.

24) Resources Available

The study is supported by a USAID $100 million five-year cooperative agreement with the UC Davis One Health Institute and by the full research expertise available at Consortium partner and local implementing partner institutions. We anticipate that the research field activity (e.g. focus groups, ethnographic interviews, etc.) will last approximately two months in duration at each site once implementing teams are trained in all research methods and procedures and local ethics approval has been secured.

All research activities, including training in-country research teams, will be coordinated and supervised the PREDICT team under the guidance of C. Johnson, M. Miller, K. Saylors, C. Monagin, D. Wolking, E. Hagan, and T. Gabourie (see brief bio- sketches below).

All in country research activities, including assent and consent using the information sheet described above (see Appendix A for the templates for

both interviews and focus groups), will be implemented by research personnel trained by the PREDICT team. The PREDICT researchers will support in country teams with study implementation and data analysis.

Personnel:

Dr. Christine Johnson is the Senior Biological and Ecological Surveillance Coordinator for PREDICT with extensive experience in global health research and in the design and implementation of disease surveillance and risk characterization studies in human and animal populations. As Lead PI at UC Davis, Dr. Johnson will supervise research activities and coordinate with PREDICT's Global Operations Officer (D. Wolking) to assure the study is conducted in compliance with all appropriate ethical and regulatory guidelines at all sites.

Dr. Maureen Miller is the Senior Behavioral Surveillance Coordinator for PREDICT based at EcoHealth Alliance, and is a social scientist with degrees in both epidemiology and medical anthropology. She has extensive experience in applied infectious disease prevention research, programming and policy. Dr. Miller, together with Dr. Saylors, provides the technical leadership for this study and led the design of proposed research methods and development of training protocols and data collection tools. Dr. Miller will provide critical leadership for all participating country teams and will support training and implementation, data analysis, and results communications.

Dr. Karen Saylors is the Deputy Behavioral Surveillance Coordinator for PREDICT, and is a medical anthropologist and Senior Director of Behavioral Risk Analytics with Metabiota Inc. Dr. Saylors has led research in applied anthropology and behavioral sciences in Central and West Africa and Southeast Asia. Together with Dr. Miller, Dr. Saylors provides the technical leadership for this study and led the design of proposed research methods and development of training protocols and data collection tools. Dr. Saylors will provide critical leadership for all participating country teams and will support training and implementation, data analysis, and results communications.

Dr. Corina Monagin is the Lead Surveillance Coordinator for Metabiota, Inc. and has extensive experience in infectious disease and public health surveillance research at the human-animal interface in Africa and Asia. As a member of the PREDICT Behavior Risk team, Dr. Monagin supported the design and development of the proposed study and data collection tools and will provide support to local country teams for training, implementation, and analysis.

Mr. David Wolking is the Global Operations Officer for PREDICT based at UC Davis and has extensive experience in infectious disease research at the human-animal interface in Africa and Asia. As a member of the

PREDICT Behavior Risk team, Mr. Wolking supported the design and development of the proposed study and data collection tools and will provide support to local country teams for training, implementation, and analysis. Mr. Wolking will also support Lead PI (Dr. Johnson) as primary contact to assure compliance with the study protocol across all sites.

Ms. Emily Hagan is a Research Coordinator based at EcoHealth Alliance and has a BS in biology, an MPH in epidemiology, and an extensive background in infectious disease immunology. Ms. Hagan is a member of the PREDICT Behavior Risk team, and will provide support to local country teams during training, implementation, and analysis.

Ms. Taylor Gabourie is the Project Support Coordinator based at UC Davis. An applied anthropologist, Ms. Gabourie is a member of the PREDICT Behavior Risk team, and will provide support to local country teams for training, implementation, and analysis.

25) Prior Approvals

Prior to commencing research at specific sites, we will seek approval of this study from all participating countries through Institutional Review Boards, ethical clearance councils/committees, and national research administrations following local regulatory guidelines as appropriate. Research will not commence until approval has been granted.

26) Provisions to Protect the Privacy Interests of Subjects

If an individual decides to participate in this study, his or her participation and any and all information provided is completely confidential. No personal identifying information will be collected. A unique identification (ID) number will be written on the information sheets BEFORE the interviews, and focus groups begin. That is, before an individual is even identified for an interview or focus group. The number will only serve to monitor participation in the study.

If the results of this study are published, no individual will be identified or named in any reports. No personal identifiers will be collected. All data collected will be uploaded into a secured, encrypted database and paper documents will be destroyed after confirmation that data has been successfully uploaded. Study databases will be secured with password-protected access systems with controlled distribution web-based certificates and will not contain any personal identifiers. Access to all data will be limited to staff analysts and lead researchers involved in this study. Any health information disclosed by an individual will not be used by or disclosed (released) to another institution. Any reports published or shared with partners will not contain any personal identifying information for individual participants.

27) Compensation for Research-Related Injury

NA – Minimal risk

28) Economic Burden to Subjects

NA – There is no cost to subjects to participate.

29) Consent Process

The consent process is not being conducted by UC Davis or Consortium personnel but by the implementing partner research teams in each participating country and will be implemented in accordance with permissions and guidelines through the relevant local authorities.

To ensure compliance with informed consent procedures, all potential participants and parents of potential minor participants (ages 10 to 17 years) will be given an information sheet prior to being asked to participate in the study (for both interviews or the focus groups). The participant will review the information sheet with the research staff and will be given time to ask questions. When reviewing the information sheet, study staff will explain details of the study including why they were selected, potential risks to their participation, how their participation is beneficial, that their participation is completely voluntary, and that they can withdraw their participation at any time. It will be explained that the researchers will not share responses, and a small token or gift will be given for their time spent in the study.

Parental consent will be required for all children aged 10-17 by one parent, and assent will be obtained from all children. Unaccompanied minors living at or visiting sites will not be allowed to participate. Adults unable to consent for any reason will not be included in the study. During the interview, the local research team will take care to ensure all aspects of the consent procedure are followed and that participants fully understand that the activity is completely voluntary and that they may choose to end the interview at any time. Measures will be taken to assure the respect, dignity, and freedom of each participant.

This process will take approximately five minutes and the statement will be read in the local language. The information sheet for this study (both interview and focus group sheets) will be translated from English to the local language by the implementing research team in each country. All field researchers involved in the interview or focus group data collection and consent process will be required to be fluent in the local language in order to ensure that participants understand the study and the interview process.

30) Process to Document Consent in Writing

We are requesting a waiver for written documentation of consent.

31) Drugs or Devices

No drugs or medical devices will be used in this study. Tape recorders will be used to record the ethnographic interviews and focus groups.

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Research Subject Information Sheet - Interviews

Sponsor: USAID PREDICT 2
Protocol Title: USAID PREDICT 2 Qualitative Instrument Pilot Testing
Investigator: Dr. Christine Johnson, PhD

Introduction. I (we) work for a project called *PREDICT* funded by the US government and conducted by several U.S. institutions and local partners around the world. We are studying how the health of wildlife, livestock, and people affect each other to better understand patterns of behaviors that may impact health.

Interview. As part of this research, we are speaking with people to better understand the types of interactions people have with wildlife and their domestic animals, as well as how people live their lives, do their jobs, and take care of their families and animals. While you may not benefit directly from this research, the information you share with us may help to improve the health of other people who live near or work with animals. The main risk to you would come from a loss of confidentiality. To decrease any risk of someone else seeing your personal information, we give the information you share with us and the recording of the interview, a code number and use that instead of your name on all information that you provide. Your information is also kept secure in locked files and is considered confidential. We will use this information to better understand disease risks from wild and domestic animals to humans and share this with local and national leaders, non-governmental organizations and the scientific community. When we write about the study, we will not use your name or anyone else's name, or anything about you that someone could recognize. At the end of the interview, we may ask you to refer other people to the study.

I am here today to ask if you are willing to participate in this study by talking with me. Your participation is completely voluntary. You do not have to answer a question if you do not want to. The interview will take about 60-90 minutes depending on the discussion. If you agree, your interview will be audiotaped. If you are not confortable with your interview being recorded you are free to either request an unrecorded interview or to decline to participate in the study.

Additional Information: An Institutional Review Board that is responsible for making sure that research participants are protected from harm has approved this study. If you have any questions now or in the future about your participation in the study or your rights as a research subject, you many contact the project Principal Investigator Dr. Christine Johnson at +1-530-752-5770 (ckjohnson@ucdavis.edu).

APPROVED by the Institutional Review Board at the University of California, Davis	
Protocol	Approved
754490	05/20/2015

Unique ID:_____ Date:_____

Statement of Consent

I have had a chance to ask questions about the study. If I do not want the interview recorded, I may say no to participating in the study. Also, someone has explained to me that:

- No personal identifiable information like my name will be recorded, only a code number will be used
- The information I provide is confidential and will be kept in locked files that only the professional research staff will see
- All written and published information will not use my name, anyone else's name, or anything about me that someone could recognize
- There is no punishment or disgrace with saying no to participating in the study. If I decide to participate my decision will not be used against me in any way.

The respondent has voluntarily agreed to participate in this survey.

_____ Individual agrees to participate in this survey

OR

_____ Individual declines to participate in the survey. Please list why if respondent is willing to explain and thank them for their time.

Reason for not participating: _____

Certified by Interviewer _____Initials _____Date _____

Research Subject Information Sheet – Focus Groups

Sponsor: USAID PREDICT 2
Protocol Title: USAID PREDICT 2 Qualitative Instrument Pilot Testing
Investigator: Dr. Christine Johnson, PhD

Introduction. I (we) work for a project called *PREDICT* funded by the US government and conducted by several U.S. institutions and local partners around the world. We are studying how the health of wildlife, livestock, and people affect each other to better understand patterns of behaviors that may impact health.

Interview. As part of this research, we are speaking with people to better understand the types of interactions people have with wildlife and their domestic animals, as well as how people live their lives, do their jobs, and take care of their families and animals. This interview is in a group setting with approximately 7 to 10 other people. While you may not benefit directly from this research, the information you share with us may help to improve the health of other people who live near or work with animals. The main risk to you would come from a loss of confidentiality. To decrease any risk of someone else seeing your personal information, we give you a code number and use that instead of your name on all information that you provide. Your information is also kept secure in locked files and is considered confidential. We will use this information to better understand disease risks from wild and domestic animals to humans and share this with local and national leaders, non-governmental organizations and the scientific community. When we write about the study, we will not use your name or anyone else's name, or anything about you that someone could recognize. At the end of the interview, we may ask you to refer other people to the study.

I am here today to ask if you are willing to participate in a group discussion. Your participation is completely voluntary. You do not have to answer a question if you do not want to. The group discussion will take about 60-90 minutes and will be recorded. If you are not confortable with the group discussion being recorded you are free to decline to participate in the study.

Additional Information: An Institutional Review Board that is responsible for making sure that research participants are protected from harm has approved this study. If you have any questions now or in the future about your participation in the study or your rights as a research subject, you many contact the project Principal Investigator Dr. Christine Johnson at +1-530-752-5770 (ckjohnson@ucdavis.edu).

Unique ID:_____ Date:_____

Statement of Consent

I have had a chance to ask questions about the study. If I do not want the interview recorded, I may say no to participating in the study. Also, someone has explained to me that:

- No personal identifiable information like my name will be recorded, only a code number will be used
- The information I provide is confidential and will be kept in locked files that only the professional research staff will see
- All written and published information will not use my name, anyone else's name, or anything about me that someone could recognize
- There is no punishment or disgrace with saying no to participating in the study. If I decide to participate my decision will not be used against me in any way.

The respondent has voluntarily agreed to participate in this survey.

_____ Individual agrees to participate in this survey

OR

_____ Individual declines to participate in the survey. Please list why if respondent is willing to explain and thank them for their time.

Reason for not participating: _____

Certified by Interviewer _____Initials _____Date _____

ETHNOGRAPHIC INTERVIEW GUIDE

Core Themes

1. Human movement
2. Socioeconomics
3. Biosecurity in human environments
4. Illness, medical care/treatment and death of humans
5. Human-animal contact

HUMAN MOVEMENT

GOAL: To understand living environment and 'home range' (e.g., how far people travel and why).

Home

Where do you live/what kind of dwelling? How many people are in the household? How many rooms? How many are children? Is everyone related? Sleeping arrangements?

How often do you move? Any seasonality of movements?—eg, for work, for food, for safety (e.g., against flood, drought, conflict)?

What are the things you do to protect your home (against predators, animals, outsiders, bad weather)?

Work

What kind of work or activities do you do? What do other household members do? Where do these activities happen?

How do you protect your activities and business interests? (e.g., grazing or crop land, business competition, hunting territory, animal stock)

Travel

How far do household members travel from home and why? (Follow up on animal related issues: shopping, selling/buying/trading, hunting, transport, etc)

How travel (by foot, bike, cart, truck, plane)? Is it ever for overnight? Where stay?

Why traveling? (work/migrant, family, religion, holidays, to sell/trade/buy animals)

Other family members in other areas of the country? Visit often?

Observed environment

Have there been any changes in the environment: new roads, more boats or ports, fields, buildings, population movement (in or out), land clearing or abandonment, new houses, other new buildings

Who is responsible for the changes? Are the changes good or bad?

SOCIOECONOMICS

GOAL: To understand a typical day and how money and social standing impact opportunity and risk.

Daily routine

Tell me about your daily routine (get description of work on a usual day, include purchasing and preparing food, timing of types of meals, responsibilities/duties related to animals, any changes by season)

How do people in the household contribute to earning money and getting food (and water)?

Where do the children play? Who takes care of the children when you are at work?

Animal responsibilities

Describe the animal related jobs and responsibilities for people at every age (i.e., young children, older children, young adults, adults, elderly).

What are the skills/knowledge needed before moving to the next stage of duties/responsibilities?

Are there differences in responsibilities between boys and girls, men and women, by ethnicity or class?

Education

How many children are currently in school? Until what age do your children go to school? (boys and girls?)

What is your level of education? Why did you stop?

Economics

Do you make more money than other people who do the same things as you? Why do you think that is?

Are there times of year when you make less money? What happens then?
Are there times when food is more expensive than others? Tell me about that (eg, different food availability, seasonal, festival related).
Do you think you and your household are better off than most people? Could you do things to make it better?

BIOSECURITY IN HUMAN ENVIRONMENTS

GOAL: To determine if any sanitation or hygiene factors could play a role in disease spillover

Water and food

Is there a central source of water? What is the source? (eg, pond, uncovered well, rainwater, taps, covered well)
Is there a water source you like better?
How far away is the water source? Do animals drink from the same source?
Do you do anything to your drinking water to clean it before you drink it?
How do you store your food? (e.g., open containers, covered, hanging, refrigerate)
Do you eat or drink things where you suspect animal contact? (e.g., teeth/scratch marks, feces or urine seen)
Do you regularly clean your food prep station/kitchen and tools? How?

Sanitation

Are there toilets, latrines or other designated areas for human waste? Are these cleaned and used regularly?
Are butchering and slaughtering areas separate? How often are they cleaned and how? Who does the cleaning?
Are there any official rules or laws about human waste and garbage disposal?
Are there any animal pest control laws? What do you do to control animal pests?

Hygiene

When are the best times to wash your hands? Do you use soap? How much does soap cost and where get it?
Do you wash your hands at home? at work?
How often and where do you and your household members bathe?

ILLNESS, MEDICAL CARE/TREATMENT, DEATH

GOAL: To identify any unusual disease experiences—signs, symptoms and sources

Household illness

Is anyone sick right now?
What do you do when someone in the household gets sick? Who takes care of that person?
The last time someone was seriously sick what happened (explore when, with what, how did they get sick, who told/consulted, anyone else get sick after, final outcome)?
Has anyone ever had an sickness that people don't usually get? What happened? Where did it come from?

Illness from animals

Do you know anyone who has gotten sick from an animal? What animal? What did they get? What happened?
Do you know any other diseases/illnesses people can get from animals? How does the animal give the illness to the person? How often does it happen?

Medical care/treatment

How sick would you have to feel to stay home and not do normal routine?
Where do you go when you are sick?
Do you prefer to use traditional medicine, western medicine or a combination?
How sick would you have to feel to go to doctor/clinic/hospital? What does that cost? (in time, lost wages/business, transport costs, etc) How far away?

Death

What is the tradition when someone dies? (Explore if reported to authorities, differ by age or gender, what happens to the body, does the community come together or is it private.)

HUMAN ANIMAL CONTACT

GOAL: To gain knowledge about interactions with animals, animal health and animal perceptions and knowledge.

Encourage but don't lead discussion about which animals. Allow respondent to name the animals. If no birds or bats are mentioned, follow up by asking specific questions about birds and bats.

Indirect contact

What kind of meat do people in your household eat? How do you get it/where does it come from? What is furthest away an animal comes from?

Is meat dead or alive when you get it? If dead(/prepared), how to tell if good/fresh?

If alive, how long are live animals kept before being sold or eaten? How do you get live animals home?

How is meat prepared (raw/undercooked)? Is meat prepared in the same place as other activities? (e.g., preparing vegetables, cleaning babies/changing diapers, where other food or drinking water is stored)

Do animals come in or near the dwelling? How do you know animals are there? Which animals?

Direct contact

Do you or someone in your household handle live animals? In what context? (e.g. ranching/animal husbandry, hunting, wet markets, work, around dwelling/other building, pets)

What are the animals that you keep/raise or sell? How many different kinds of animals? How many of each? For how long do you have the animals?

Where do live animals come from? Where is the furthest away an animal comes from?

Who buys/trades for your live animals? Where do the animals go?

Have you been bitten, scratched or had bleeding after handling an animal? By a wild animal?

Where are live animals slaughtered? butchered? Do people buy or sell parts?

Do you travel with animals? Explore details of the process, specific routes and encounters (eg, with other animals, with animal transport supporting industries, such as holding areas, restaurants, hotels) along the way. Explore for differences over time in animal handling, eg, seasonality, legal, religious, animal reproduction

Animal products/rituals

Other uses of animals—e.g., as pets, medicine, magic, fertilizer, for trading

Rules for children around wild animals as pets, playing with wild animals or dead animals

Animal health

How do you care for your animals: how are they fed, what do they eat, where do they eat/graze and sleep? Are they segregated or all together? Differences by season? day/night? Does anyone live or stay with the animals? Is there a central area for animal waste? How often are animal cages, stalls, or penned areas cleaned? Who cleans them?

Do the animals get veterinary care? Vaccinations?

How do you know when an animal is sick? What's the first thing you do about a sick animal?

Have you seen an animal outbreak or die-off? What happened?

Perceptions and knowledge

What are the most unusual animals anyone can buy?—seasonal? Expensive? Who buys?

Are there any animals you avoid eating? Why? Ever heard of anyone eating/selling dead or infected animals?

Do people ever eat non-domesticated animals/wildlife? Where do they get them?

Who usually buys wildlife products? Have there been changes over time?

What do you do when you find a dead animal?

What laws about animals do you know? (eg, limiting/outlawing hunting, reporting and culling of sick animals)

FOCUS GROUP GUIDE Version 2, May 1, 2015

The focus group discussion is initiated by naming all of the animals that can be found in the community. The goal of this exercise is to explore animal diversity.

The community mapping activity locates where the different kinds of animals can be found relative to the site of the focus group. It should be emphasized that this will not be an 'accurate' map. This exercise is designed to assess the distribution and overlap of animals. Prompts such as 'anywhere else?' should be used. The animal list will contain insects, reptiles and fish. *Map only mammalian and avian species*.

These two activities together should be limited to 10-15 minutes. The themes to be explored in the discussion are 1) contact and context, 2) illness in animals and humans, and 3) rules and restrictions. Events such as animal die-offs should be added to the map, if they are discussed.

1) Contact and context

- Which of these animals do you see the most often? The least? (Probe: where, why)
- What animals do you come into physical contact with? (Probe: where, why, how often)
- Which of these animals do you eat?
    - Where do you get them? How are they prepared? Which are for special occasions only?
- What are animals good for other than food? (probe: labor, medicinal, magic, pets, by-product uses)
- Which animals come into buildings or places where people are? Is water shared with animals?
- How are unwanted animals kept out? (probe: which animals, all methods used)
- Who takes care of the animals? (Probe: who, specific jobs, animal movements)

2) Illness in animals and humans

Animals

- What happens when animals get really sick? How are the animals cared for?
- Has this happened recently? Do people try to hide animal sickness?
- Is animal sickness reported to anyone? (probe for differences between wild and domestic animals)
- Have any animals been destroyed or killed by authorities? Describe.
- What happens to animals when they die? (probe: eaten, buried, left to rot, depends if wild or not)

Humans

- What is the most unusual or memorable sickness anyone has had? What happened?
- What are the causes of illness or sickness?
- Do you know anyone who has gotten sick from an animal? What happened?
- What do you know about animals that can give you infections or diseases?

3) Rules and restrictions

- Are there places in the community where you aren't allowed to go? Why not?
- Are there any rules about hunting or trapping animals? (Probe: cultural, legal)
- Are there any animals that you don't eat or that are avoided? Why?
- Are there official rules or laws about garbage disposal? Human waste? Animal waste?
- Is garbage a problem in this community? What's the problem?

Final question for all: If you could change one thing in your life, what would it be and how would you do it?

PREDICT 2

OBSERVATIONAL RESEARCH PROTOCOL

December 14, 2015

PURPOSE: To provide principles and general guidelines for the conduct of targeted qualitative research to understand the context and potential risk practices and behaviors of individuals at high risk of zoonotic disease spillover.

Prepared by the PREDICT-2 Behavioral Risk Group

Senior Behavioral Surveillance Coordinator: Maureen Miller, PhD
Deputy Behavioral Surveillance Coordinator: Karen Saylors, PhD

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SECTION 1: PROJECT OVERVIEW

1.1 PREDICT PROJECT OVERVIEW & GOALS

The PREDICT project is funded by USAID under the Emerging Pandemic Threats (EPT) program. Nearly 75 percent of all new, emerging, or re-emerging diseases affecting humans at the beginning of the 21st century are zoonotic (i.e. originated in animals). Notable examples of the global impact of new emergent diseases include HIV/AIDS, severe acute respiratory syndrome (SARS), and most recently Ebola. The speed with which these diseases can emerge and spread represents serious public health, economic, and development concern. The vast majority of these diseases originated in “hot spot” areas such as central Africa and South and Southeast Asia where multiple and complex factors contribute to zoonotic disease spillover into human populations.

The EPT program works in developing countries to prevent, detect, and control infectious diseases in animals and people, and places an emphasis on identifying and responding to dangerous zoonotic pathogens from before they can become significant threats to human health. The PREDICT project has two specific goals in support of this work:

1. To identify populations and practices in settings where there is a high risk of zoonotic disease spillover from animals to humans.

2. To develop policies and intervention strategies, that reduce the risk of zoonotic spillover.

The PREDICT project will focus on three key ‘pathways’ of disease emergence and spillover risk. The pathways strategically identify settings where humans, wildlife and livestock or domestic animals are most likely to come into contact with each other in a way that increases the risk of zoonotic disease spillover from animals to humans

1. **Land Conversion for Commercialization:** Rapidly changing landscapes that bring humans and animals in closer contact than was previously experienced (e.g., palm oil plantations, mining, logging, crops)

2. **Intensification of Animal Production Systems:** To feed growing global populations there have been major increases in the number of livestock (e.g., chickens, cows, goats) being raised using industrial methods. The rapid intensification of these systems has been inadequately regulated, resulting in gaps in biosecurity and biosafety measures. Frequent direct human-livestock contact occurs, often intermingling with wildlife species, in settings that vary in sanitation.

3. **Animal Value Chains:** Wildlife and domestic animals from remote naturally biodiverse regions are brought to densely populated urban markets that actively trade in varied animal species and products.

A key component of PREDICT 2 is to better understand the human behaviors and practices that may increase the risk of zoonotic disease spillover, as well as the social, cultural, environmental and economic factors that underlie human behaviors and practices. As the first step in the process, qualitative research methods will be used.

1.2 QUALITATIVE RESEARCH

Qualitative Research is an exploratory type of research that is used to gain insight into communities and people's lives. Qualitative research may be general and implemented over long periods of time. Alternatively this type of research may be targeted and focused on a set of specific issues, as is the case for PREDICT qualitative research.

This protocol reviews the objectives and methods of conducting observational research. Observational research may be conducted immediately at a site, and can be conducted at any time and over time to monitor observed changes. Observational research does not require institutional review board (IRB) or other in-country ethical committee approvals.

SECTION 2: OBSERVATIONAL RESEARCH

Purpose: Observational Research is a first step in the research process. This type of research is carried out in order to observe settings and people in their natural environments. PREDICT observational research is intended to evaluate sites for potential inclusion, to identify people who may meet the targeted population criteria at the sites, to introduce the study to the community and to monitor any changes in the sites over time.

2.1 OBSERVATIONAL RESEARCH OVERVIEW

What Is It?	Research Goals
• A first step in the qualitative research process • Passive observation and field note taking of the structure and characteristics of the site and the people who inhabit it • Informal conversations with 'key informants' • Mapping of land and community • A way to monitor changes over time	• Identify key informants • Establish relationships with individuals from target populations and key informants • Prepare for next stages of qualitative work (i.e. focus groups and ethnographic interviews) • Write up field notes of observed environment and interactions • Map the setting

Table 1 Observational Research Key Points

2.2 WHO IS INVOLVED IN OBSERVATIONAL RESEARCH

The main individuals involved in observational research are the **Observer**, **Key Informants** and any other individuals interested in speaking with the Observer in an informal way.

Observer: Is the person conducting the observational research (e.g., can be country coordinator, head field worker, or any other PREDICT staff person). The Observer should let people know about the study and the things we would like to learn. This is an excellent opportunity to engage people and to spread the word about the PREDICT project. The Observer should pursue informal and active introductions to people and members of the target communities, especially people of influence. Identification of formal

leadership structures will be important in terms of identifying opportunities and challenges for the implementation of the study, as well as any future interventions targeting structural or behavior change.

The Observer is often introduced to people of influence by local contacts that have already been established. This is the easiest way to identify key informants who may then introduce the Observer to others. It is much more challenging to engage in informal conversations without local contacts, but not impossible. Simple observation of the setting should provide clues to identify the people in authority or who have influence. This observed information is just as important and should be collected independently of any informal conversation by the Observer.

Key Informant: To gather information rapidly on a particular topic, such as the locations, practices and activities of the target population, it is necessary to identify people of power in the community (e.g., government officials, business people) or those with influence with the target population (e.g., religious leaders, market managers, community elders). Key informants are often those who are easy to approach. It is important to speak with a range of key informants.

2.3 OBSERVATIONAL RESEARCH METHODS

Observational Research methods include making observations, having informal conversations with community members who are willing to speak with the Observer, and mapping the sites being considered for future surveillance and sampling. All of this research must be documented as Field Notes.

Field Notes (ie, the data collected in Observational Research), can help contextualize subsequent qualitative or quantitative findings. Observational research can be conducted independently by the Observer or with the help of key informants, who guide the observational experience through their intimate knowledge of the area and culture. Excerpts from Field Notes are included in Appendix I.

The observational process entails looking for specific features of a potential research site, meeting people, talking with anyone who is interested, identifying individuals in positions of authority or influence in the target community or those who interact regularly with the target community, and trying to establish relationships with these individuals.

In addition, drawing maps of potential surveillance and sampling sites is an important and visual way to document the human environment. For example, an important feature in a market may include the separation of livestock and wildlife in different sections of the market. Hand-drawn maps can serve as reminders of where specific features are located or, over time, if these features change. Examples of maps are included in Appendix II.

Observational research should continue through the life of the project. Observational research does not require IRB approval.

APPENDICES

I. OBSERVATION FIELD NOTES EXCERPTS

Brief Summary

Observer: Jim Desmond
Date: Sunday, November 2, 2014
Setting: Guangzhou TaiPing Market (SARS market)
Weather: Overcast and comfortable weather
Time: 10:30am – 12:30pm

Tai Ping market is about 100 km southwest of GaungZhou. I had previously visited this market with GuangJian and Jin Ping in 2011. At that time there were many more animals, both domestic and wild, at this market.

The market is quite large, covering a large area. On this particular many of the stalls were closed and there didn't seem to be a lot of activity, not many buyers. The market is divided into two sections. There is a section that contains, reptiles, amphibians, fish and other aquatic animals. The other section contains birds and mammals. We focused solely on the bird and mammal section.

There were approximately 50 vendors – but that is a very rough estimate and it's also difficult to say if some of the closed shops were only closed that day or if they were closed permanently. Of the vendors that were open they generally seemed to sell either birds or mammals but not both. With birds, there was more mixing with vendors selling a variety of chicken, goose and duck breeds as well as pigeons. Some vendors had pheasant or quail. Some of the duck breeds looked like wild birds, for example there were a lot of mallards and there were other ducks that I could not identify the species but they did not look like domestic ducks. My guess is they are farmed but at some point in the past they had been wild caught. There was a roughly and equal number of bird vendors vs. mammal vendors

We observed a wide variety of mammals, a mixture of wild and domestic. However, there were far fewer mammals present and much less diversity than our previous visit in 2011. GJ said that the market had been shut down several months following our visit due to an article published in the paper regarding the illegal wild animal market. All the vendors are aware of the risk of disease. GJ said he overheard some guys talking when we got out of the car and they assumed we were looking for diseases in the animals. The presence of westerners definitely is a red flag for them and maybe even the presence of non-local Chinese. Unless you speak the local dialect, vendors there will be unwilling to speak with you according GJ.

Here is a list of some of the animals seen: wild boar, bamboo rats, another species of wild rat, nutria, raccoon dogs, another type of wild rodent? That looked a bit like a marmot - need to look it up, domestic cats, domestic dogs, goats, cows (jerseys). I may be missing a few but that covers most of it. The raccoon dogs were sort of hidden so they vendors must be concerned about them being seen. There were a lot more wild boar than the last visit but less animals and less diversity overall.

Observer: Arif
Setting: DLS in Dhaka
Dates: Jan 21-28, 2015

I spoke with some persons of DLS and also discussed with cattle traders in Dhaka city market regarding cattle marketing channel across Bangladesh. I visited three cattle Markets in Dhaka for getting information where the cattle come from.

The vast illegal trade thrives since cows are considered holy in India, and New Delhi is unable to legalize their export.It becomes 'legal' when traders pay up revenue officials in Bangladesh

They told that cattle come through Jessore border. Putkhali Khatal in Benapole border in Jessore district where is most of cattle trading occur.

Bangladesh and India share a 4,096-kilometer (2,545-mile)-long international border consisting 28 districts.Cattle traders say that cattle trading is occur in following districts:
Dinajpur, Kurigram , Lalmonirhat , Panchagarh , Thakurgaon , Meherpur , Kushtia , Chuadanga , Jhenaidah, Rajshahi , Chapainawabganj, Naogaon, Nilphamari and Jessore District

Above mentioned districts, Many cattle come across Meherpur border. Although, it is small district only 716 sq km but most are are bordered with India.Cattle trader say that even Beef illegally come through Meherpur border. After slaughtering cattle at night, the beef come across border.

I tend to think that we can choose Meherpur district in Y-1 and Jessore in Y-2.

Near to Nepal border: Thakurgaon & Panchagarh District: there is Banglabandha, a major inland port in northern Bangladesh established to provide a trade link with India, Nepal and Bhutan. The three nations are separated by 52 km only. So either Thakurgaon or Panchagarh District can be choose for Y-3/Y-4 PREDICT-2

Myanmar border: Bangladesh and Myanmar share a 193 kilometer crossing Cox's Bazar (in Teknaf Upazila) and Bandarban District. We can choose some sites with Myanmar border

It seems to me that it will be really good to include Medical doctors of One health scholar for conducting observational research under my supervision.

Finally,the present political situation is not good here . the indefinite transport blockade is still going on.

Observer: Maureen Miller
Date: 1/7/15 Wed morning 8:30 start 11:30a end
Setting: Live animal markets in Queens, New York City
Weather: frigid it snowed last night

Site 1: Almadina Halal poultry shop
Time: 9-9:30

We got lost trying to find the place and got directions from a man coming off the subway. We had to walk through a tunnel and ended up at a cross roads of abandoned looking warehouses. He sent us off in one direction while we walked in another. There were metal shops, glass works and car buyers/repairers/parts shops strewn throughout. There was one section on the opposite side of the street where houses had been converted into 3 or 4 different kinds of church congregations. Nobody was walking on the streets. The sidewalks were unshoveled, some were icy where people had walked.

We started looking for 157th street where the poultry shop we were going to was located. We ended up bumping into the guy who gave us directions at 156th. He was a guard at the blocked off street that led into a factory complex. It turns out that the complex was a distributor of live and butchered animals. We asked another guard for directions. I showed him the address. It was pretty clear that none of these guys knew how to read. I asked about the live poultry shop and he sent us back to exactly where we had come from. One of the abandoned looking buildings was actually Another shop—not the one we had targeted.

There were two delivery trucks out front advertising halal butchered goat and cow. There was also a food cart with a long line of poultry shop workers. The cart looked like regular halal, but most of the workers were buying cup-o-soup by lipton or coffee. As we stepped on the curve, we stepped over a large frozen puddle of blood. There was also quite a bit of feces around.

I went in and asked for Raja—the name of the man I had spoked with. The first guy didn't speak English. The guy behind the clear plastic ribbon protected cutout in the wall directed me to the door next door, which was for employees only. I went in and asked several people for Raja. One finally spoke English and corrected me: Raya. The room was small high ceilinged and dark. There were plastic crates about 8" high filled with chickens that could not stand up: one had 3 chickens but most had 6 or more. There was liquid deep on the floor: a combo of melting snow, urine and feces. The air was fetid, warm and difficult to breathe.

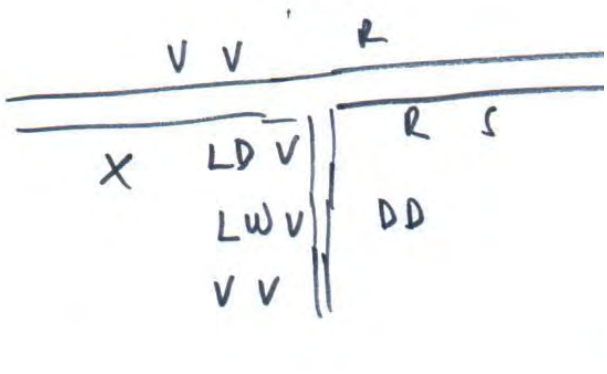
Raya came out. I explained who I was and what we wanted to do. He said he had never spoken to me. I asked if we could observe anyway. He said no, but gave me detailed directions to the shop we were trying to go to. There were many men working there and I saw one woman. I think they were Pakistani.

People were eating and drinking in with the animals and presumably the butchery and slaughter areas too.

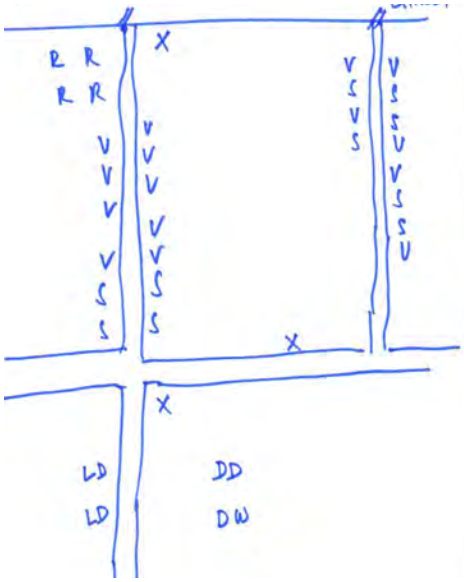
II. OBSERVATIONAL MAP EXAMPLES

Brief Summary

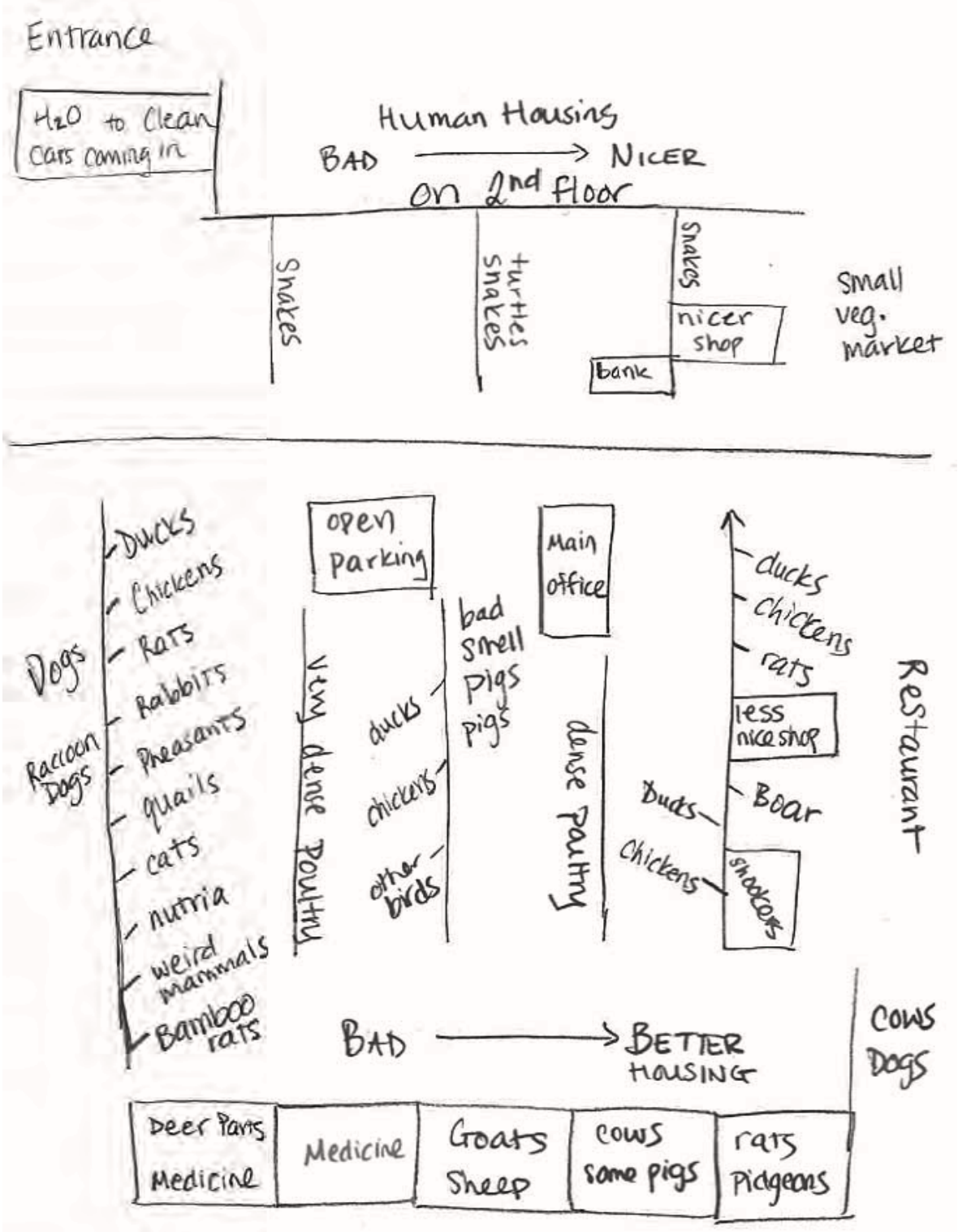
In the market sketches the clustering of vegetables (v) and staples (s) away from live animals (LD/LW) and meat (DD/WD) was considered a market implementing minimal zoning. Picture 1 is an example of a market that did not display minimal zoning as live wild animals (LW), live domestic animals (LD), vegetables (V), and domestic meat (DD) are scattered throughout the market. Picture 2 is a market with zoning – the vegetables (V) and staples (s) are kept separate from the animals and meat. Even the live animals (LW/LD) are kept separate from the animal meat (DD/DW).



Picture 1 Market Without Zoning



Picture 2 Market With Zoning



Picture 3 Enclosed market

Picture 3 is a map of a wet market that sells livestock, domestic animals and wildlife.

6.4 MODELING AND ANALYTICS – NEW RISK MAP and DEVELOPMENT OF OUTBREAK SCENARIOS FOR EMERGING PANDEMIC THREATS

PREDICT is using state-of-the-art modeling and analytic approaches to guide surveillance and help countries develop disease control and prevention strategies. PREDICT is producing next-generation, fine-scale hotspots maps, combining in-country data on land use, socioeconomic, and agricultural changes with surveys of human behavior, market value chains, and livestock production to identify where zoonoses will spillover, where they will amplify, and who is at risk.

As evidence of this approach, this year the PREDICT modeling and analytics team combined ecological niche modeling with country level data on camel density acquired from FAO to produce a hotspot map identifying areas with the greatest probability of MERS-CoV spillover from bats to camels. Findings and conclusions are detailed in the attached “Modeling the Risk of MERS-CoV-like Spillover from Bats to Camels” briefing.

Modeling the Risk of MERS-CoV-like Spillover from Bats to Camels

Challenge: There is strong evidence that MERS-CoV originated in bats and is now endemic in camels in the Middle East. This comes from phylogenetic studies of bat CoVs, evidence of MERS-CoV in one *Taphozous perforatus*, and epidemiological work in camels and people. MERS continues to infect people in Saudi Arabia, but its distribution across the region (in people, camels, or bats) is not fully known. We conducted a modeling and mapping exercise to find out:

- Where is camel production highest in the region?
- Where are bats that could carry MERS-CoV (or similar viruses) found?
- Where is the risk of future MERS-CoV spillover from bats to camels highest?

Aim: to identify potential MERS spillover hotspots so surveillance efforts can be better focused.

Our approach: We used ecological niche modeling (ENM) to predict the potential distribution of all bat hosts known to carry MERS-like (beta2c clade) coronaviruses based on known occurrence of 10 MERS-like CoV reservoirs and 35 climatic variables (**Figs 1 & 2**). We mapped country level data on camel density from FAO (**Fig. 3**). We then produced a hotspot map that identifies areas with the greatest probability of MERS-CoV spillover from bats to camels (**Fig. 4**).

Analysis and Figures

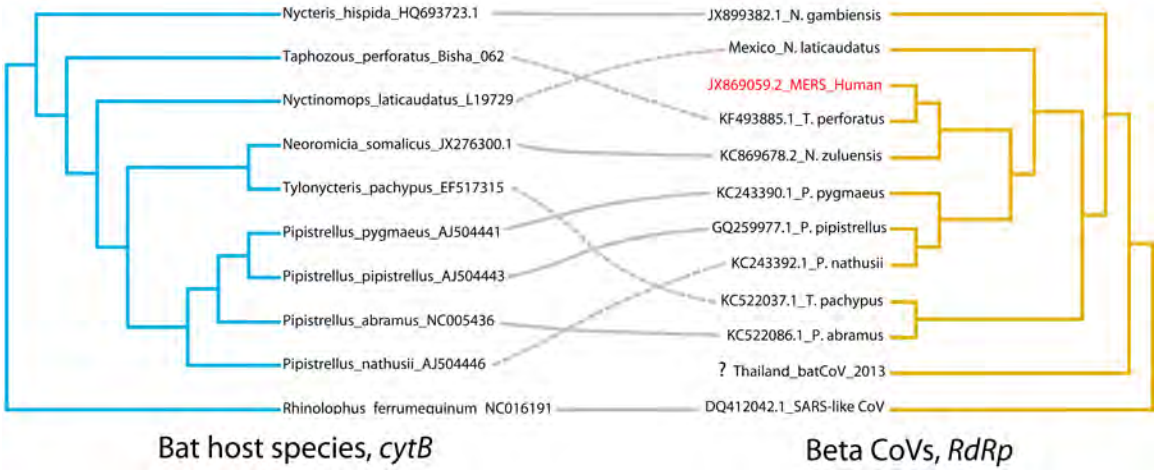


Figure 1. Cophylogeny of bat hosts and their MERS-related CoVs (beta 2c CoVs) from the published reports and PREDICT-1 data. MERS-like CoVs have moved from one bat species to another over recent historical time, and therefore are high risk for future emergence.

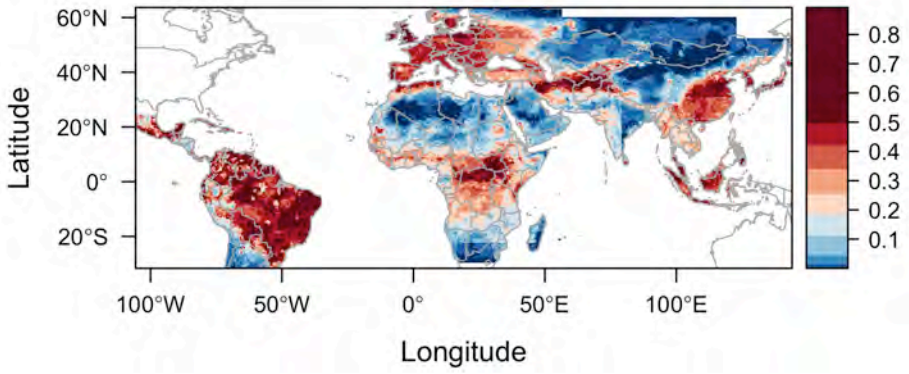


Figure 2. Modeled, projected geographic distribution of 10 species of bats known to be hosts for MERS-like viruses in **Fig. 1**. The map represents the mean relative probability of occurrence of the host bats, where warmer colors show areas with better-predicted conditions based on 35 current climatic variables that would likely affect bat distribution.

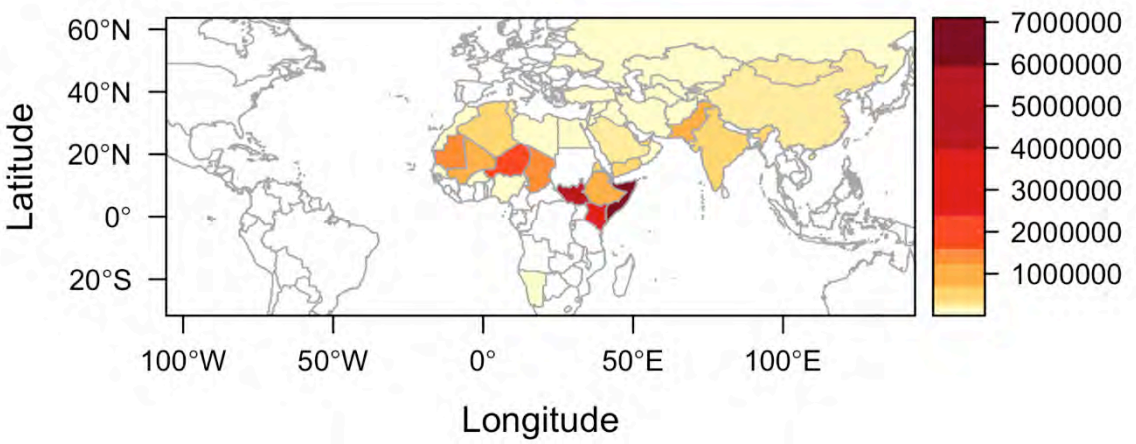


Figure 3. Global camel production (live animals) for the year 2013. This country-level dataset was used as a proxy for fine scale camel density, which is not currently available. Source FAOSTATS 2014.

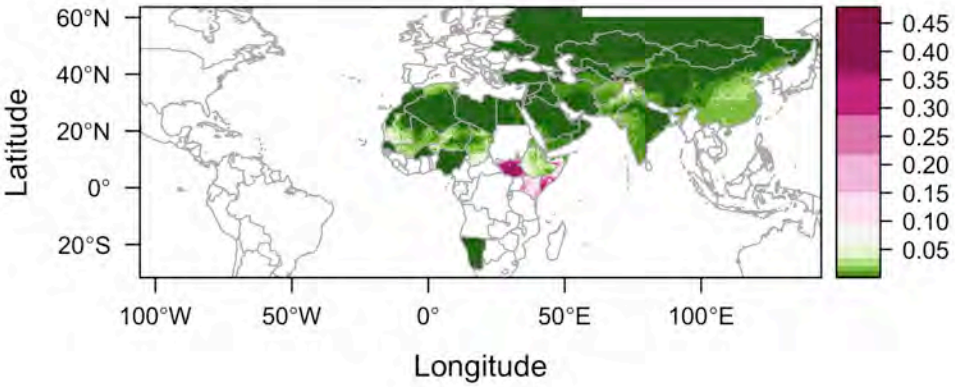


Figure 4. Hotspot map for risk of MERS-like virus spillover from bats to camels based on host distribution data. The color scale (Right) denotes the relative risk of MERS-related bat hosts and camels coming into contact, with darker colored pink areas representing higher relative probability.

Conclusions:

- Surveillance to identify future emergence of MERS should concentrate on regions in East Africa close to the Arabian Peninsula where bats that carry MERS-like viruses are most likely to occur, and where camels are produced in higher numbers.
- MERS-like viruses are probably widely distributed in bats in the Old and New World, and may emerge through other hosts in these regions (e.g. New World camelids), therefore surveillance in these species may identify other risk pathways for MERS emergence.

6.5 RISK COMMUNICATION – NEW DISEASE RISK REDUCTION MATERIALS FOR COMMUNITIES AFFECTED BY THE EARTHQUAKE IN NEPAL

Following the 2015 earthquake in Nepal, PREDICT identified points of potential support for disaster relief. Contributions to the disaster response included producing and distributing informational disease outbreak prevention and risk communication materials (posters and brochures) and working with partners at HealthMap to develop a digital disease detection and monitoring platform of health alerts and events to improve situational awareness of potential infectious disease threats.

Photo 2. PREDICT Nepal health alert monitoring platform used for real-time situational awareness following the earthquake. The site is publicly available at: http://www.healthmap.org/nepal/

Photo 4. Poster used for infectious disease risk communications in communities affected by the Nepal 2015 earthquake.

Photo 5. Leaflet used for infectious disease risk communications in communities affected by the Nepal 2015 earthquake.